NOVEMBER

Radio-Electronics

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NEW! Large-Screen Scope Covers Wide Range See Page 4

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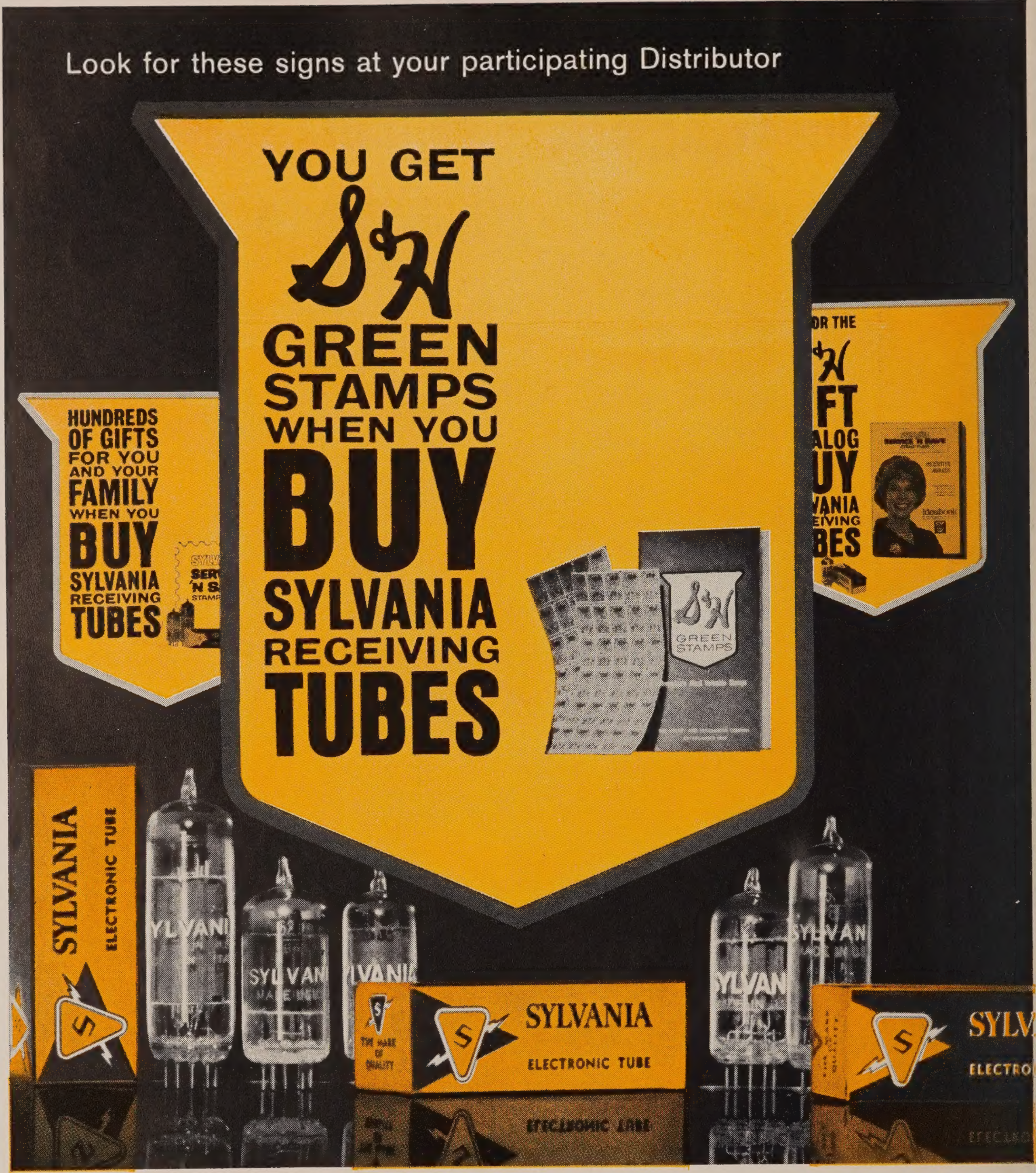
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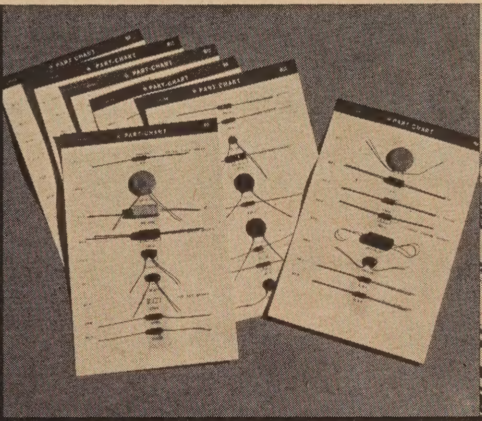
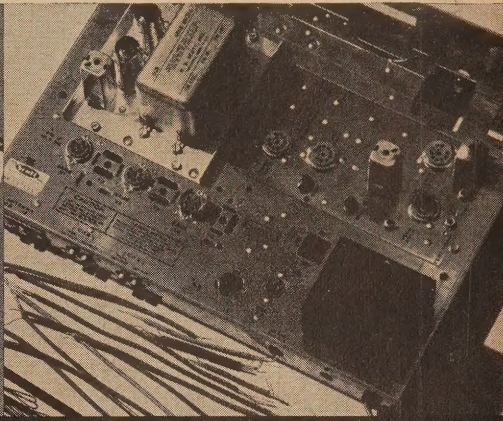
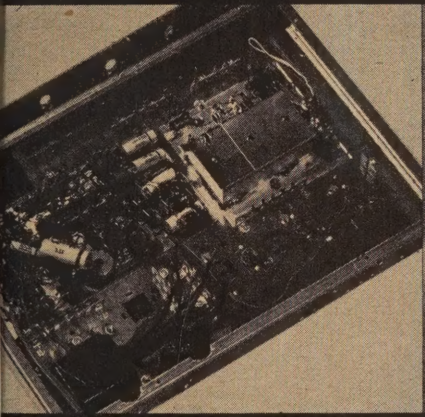


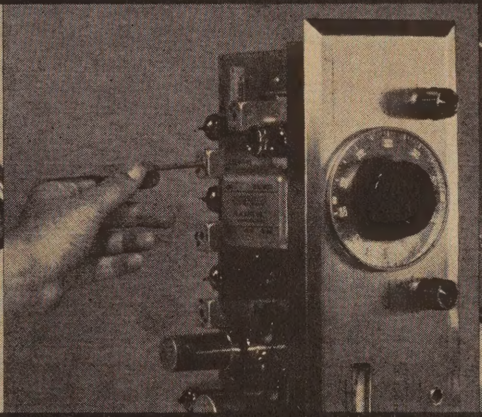
Each full color illustration is accompanied by its own Part Chart . . . another Scott exclusive. The actual parts described in the illustration are placed in the exact sequence in which they are used. You can't possibly make a mistake.



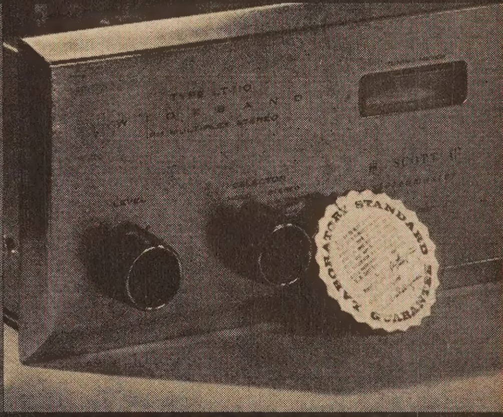
Much of the uninteresting mechanical assembly is completed when you open your Scott Kit-Pak. All the terminal strips and tube sockets are already permanently riveted to the chassis. To insure accuracy all wires are pre-cut and pre-stripped to proper length.



There are certain areas in every professional high fidelity component where wiring is critical and difficult. FM front ends and multiplex sections are an example. In Scott Kits these sections are wired at the factory, and thoroughly tested by Scott experts, assuring you a completed kit meeting stringent factory standards.



Tuners are aligned with the unique Scott Ez-A-Line method using the meter on the tuner itself. This assures perfect alignment without expensive signal generators. Amplifier kits require no laboratory instruments for perfect balancing.



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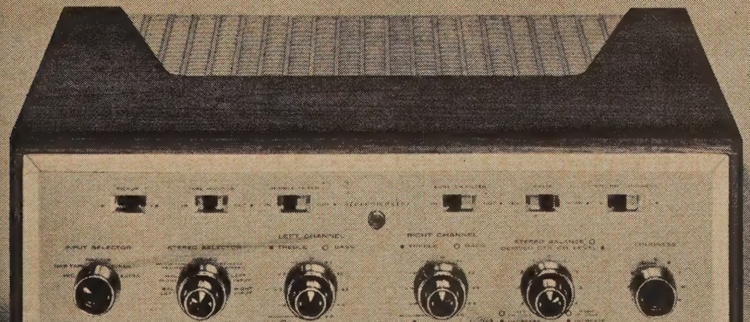

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*Audio — February 1961, Pages 54-56

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Radio-Electronics

NOVEMBER 196
VOL. XXXIII No.

Formerly RADIO CRAFT—Incorporating SHORT WAVE CRAFT—TELEVISION NEWS—RADIO & TELEVISION*

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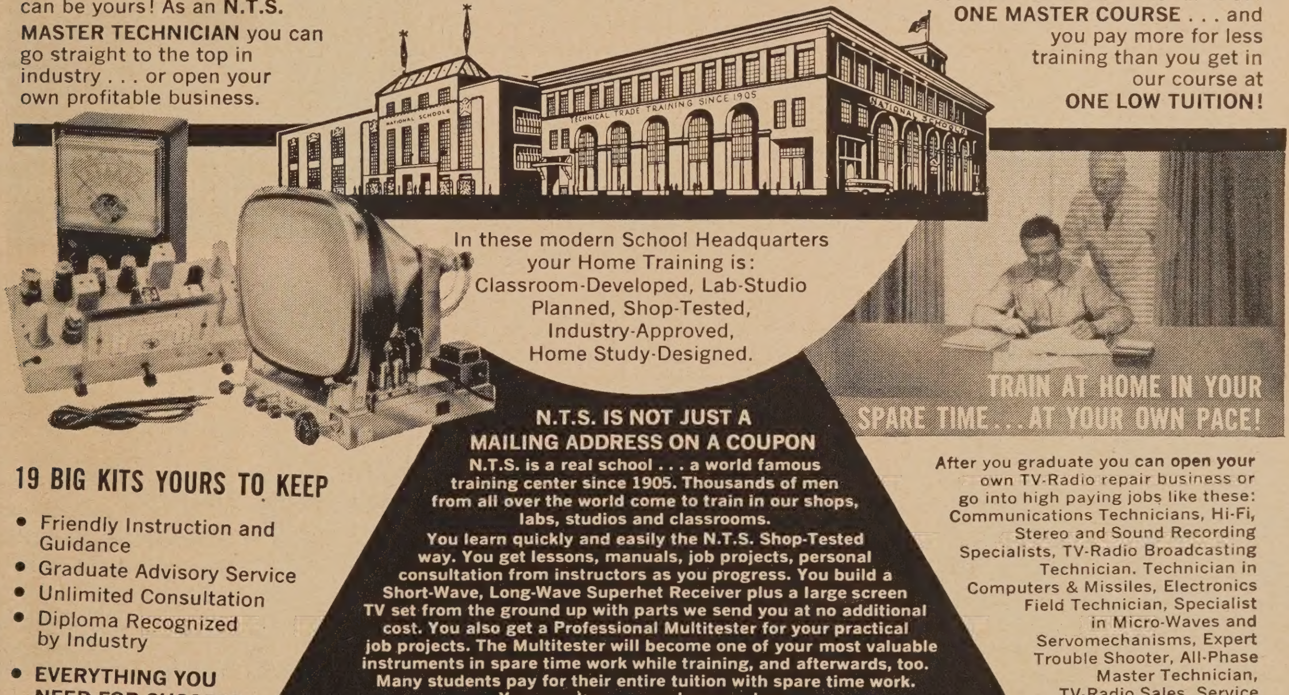
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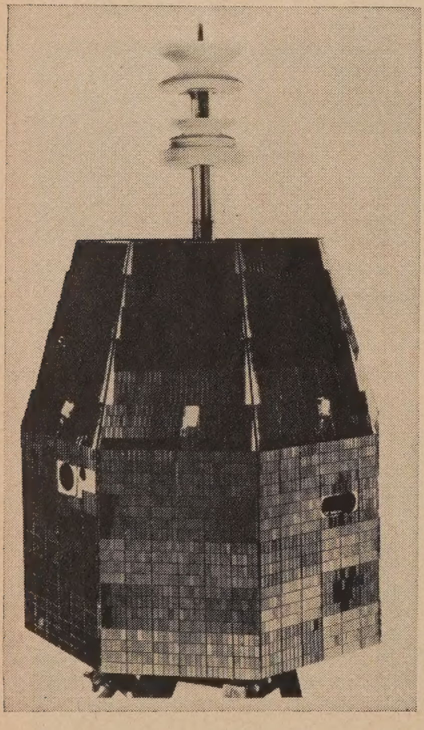
News Briefs

New Satellite Project To Link US and Brazil

A North and South link has been scheduled by the International Telephone and Telegraph Co. in cooperation with the government of Brazil. It will go into effect when the Project Relay satellite is launched late this year. The Relay satellite is planned to orbit the earth at altitudes ranging from 800 to 3,500 miles. A completely mobile ground station has been constructed for use near Rio de Janeiro. It includes a 30-foot parabolic tracking antenna, control-band and auxiliary trailers, and will be operated by the ITT subsidiary Companhia Radio Internacional do Brasil.



Relay Spacecraft being constructed by RCA for NASA is an eight-sided prism, tapered at one end. Weight 169 lbs., diameter 29 inches, height 32 inches, with 19-inch long communications antenna extending from the narrow end. The surface is covered with 8,215 solar cells, shielded from radiation damage by a layer of quartz 60 mils thick. NASA will conduct experiments on Relay's operating condition at the ITT station at Nutley, and at another NASA test station at Mohave, Calif., before communications experiments are carried out.

The power of the ground station is 10 kw. The Project Relay satellite will put out 10 watts. The project is a purely experimental one, designed (1) to test feasibility of communications in this direction; (2) to detect radiation particles in the Van Allen belt, and (3) to determine the extent of radiation damage to solar cells and electronic components. The mobile station will be able to handle 12 simultaneous two-way telephone messages or 144 teleprinter or high-speed data circuits.

Experimental work between the United States and Europe will include television, teletype, high-speed data transmission and telephone communication. The signals will be transmitted to the satellite on 1,725-mc or 2,300-mc and from the satellite on 4,170-mc.

The northern link in the communications experiment will be operated at the ITT Federal Lab at Nutley, N. J., which has received the country's first FCC license allocating radio frequencies to private industry to operate an experimental research facility of this type.

Simple Equipment Good For Telstar Communications

Relatively inexpensive equipment was used to provide a single two-way voice channel via the Telstar satellite at a demonstration at Bell Labs, Holmdel, N. J. Several two-way telephone conversations were completed. The path of the calls was from a small temporary 850-watt transmitter at Holmdel to Telstar and down to the big space communications station at Andover, Me. From Andover the calls were sent back to Holmdel over regular phone circuits. The other side of the calls went from Holmdel to Andover via land lines, up to Telstar and back via radio to Holmdel. Transmissions were on 6384.58 mc and reception on 4165 mc.

At Holmdel a remodeled 18-foot dish antenna together with other existing equipment formed the communications station. While the capabilities of such a station do not compare to the Andover establishment, it can provide basic service where needed.

All control equipment is housed in a rather ordinary house trailer. Although an 18-foot dish was used for the demonstration, a properly designed 10-foot dish could do the same job, it was stated.

TELEPHONE
VIA TELSTAR
(HOLMDEL STATION)

Larry Steckler, Associate Editor, Radio-Electronics, communicating via Telstar.

Smithsonian Honors First Plane Radio Operator

A bust of Elmo Neale Pickerill, the first person to transmit radio signals from a plane to earth, has been installed at the Smithsonian Institution National Air Museum. Mr. Pickerill learned to fly under Orville Wright, for the purpose of attempting the wireless transmission.

During his historic flight on Aug. 4, 1910, he communicated with a portable ground station at Manhattan Beach, N. Y., from an air position above Mineola, 20 miles away. He also established two-way communication with the Marconi stations at Sagaponack and Sea

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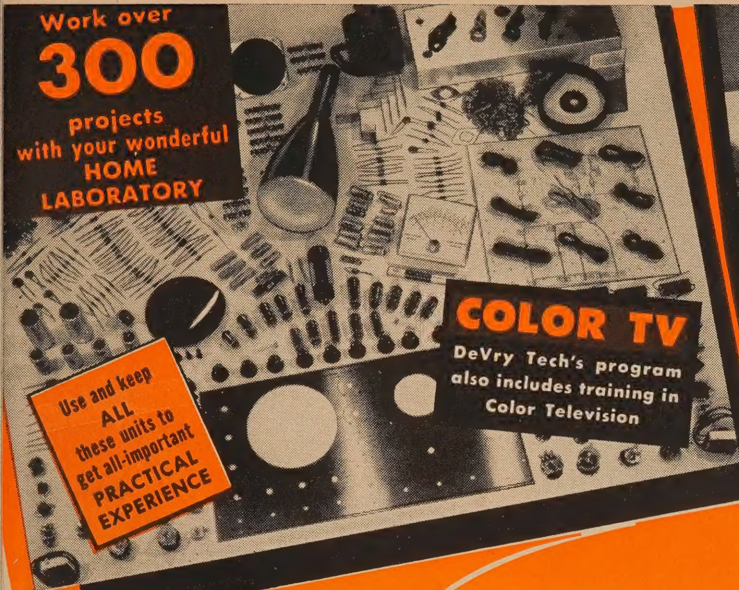

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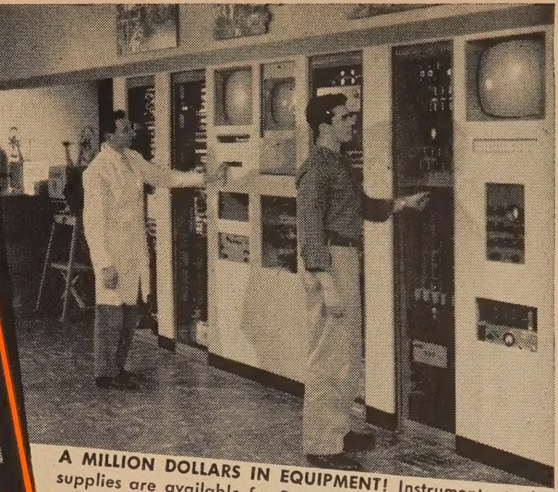

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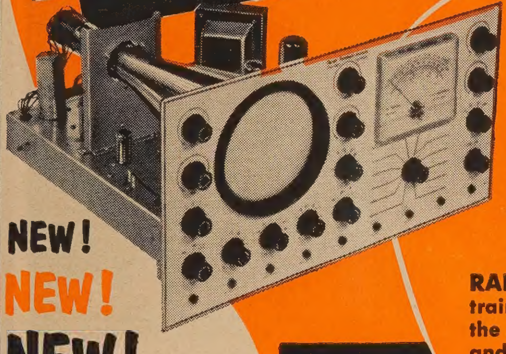

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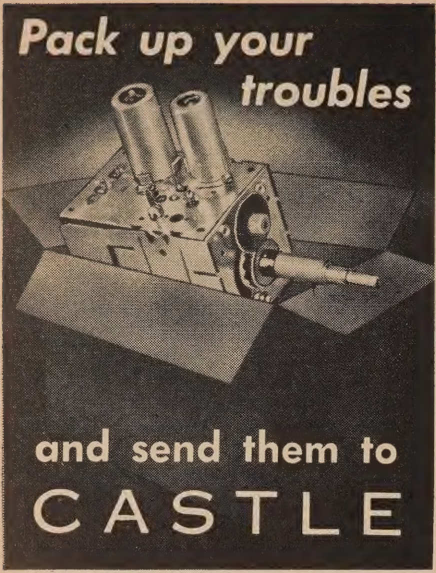

Ask yourself

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Pioneers in TV Tuner Overhauling

Gate, also on Long Island, N. Y., the marine station of United Wireless Telegraph and five steamships in the area. Using a 200-foot wire trailing from one wing tip as antenna, and a second one from the other wing tip as an "artificial ground," Mr. Pickerill also laid to rest fears that airplane transmission could not be practical because of the impossibility of making a good ground.

The presentation to the museum was made by Mr. Pickerill himself, who is now 77 and lives at Mineola. The bust was commissioned and presented to Mr. Pickerill in 1939 by his friend Augustus Post, a New York financier, and one of the founders of the Early Birds Association, in recognition of his services to radio and aviation.

Gallium Arsenide Diode May Do Maser's Work

According to scientists of the Massachusetts Institute of Technology, a gallium arsenide diode, emitting very powerful radiation in an exceedingly narrow range of frequencies near the visible light spectrum, may do many of the things now proposed for optical masers (lasers). The high power and narrow bandwidth of the energy from the diode, and the very high speed with which it responds to a change in the input signal, make it seem especially adaptable to such work. The diode was pictured on page 60 of last month's issue, although little information on it was available at that time. Equipment has already been devised that will transmit 20 TV channels or 20,000 voice channels on a single beam of intense infrared. The new device was developed by R. J. Keyes and T. M. Quist of MIT's Lincoln Laboratory, Solid State Division, with the joint support of the Armed Forces.

Calendar of Events

ISA Instrument-Automation Conference and Exhibit, Oct. 15-18; New York Coliseum, New York, N. Y.

Symposium on Space Phenomena and Measurement, Oct. 15-18; Statler-Hilton, Detroit, Mich.

Third New York Conference on Electronic Reliability, Oct. 19; Stevens Institute of Technology, Stevens Center, Hoboken, N. J.

Society of Motion Picture & TV Engineers Convention, Oct. 21-26; The Drake, Chicago, Ill.

1962 Computer Applications Symposium, Oct. 24-25; Morrison Hotel, Chicago, Ill.

1962 Electronic Devices Meeting, Oct. 25-27; Sheraton Park Hotel, Washington, D.C.

17th Midwest Quality Control Conference, Oct. 26-27; Denver Hilton Hotel, Denver, Colo.

Conference on Spaceborne Computer Engineering, Oct. 30-31; Disneyland Hotel, Anaheim, Calif.

EIA Loudspeaker Industry Meeting, Nov. 14; Pick-Congress Hotel, Chicago, Ill.

2nd Canadian IRE Communications Symposium, Nov. 16-17; Queen Elizabeth Hotel, Montreal, P.Q., Canada.

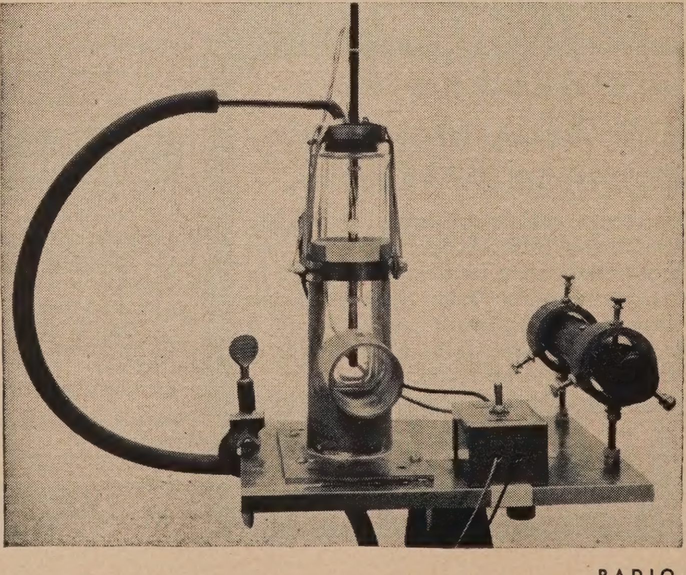
MAECON (Mid-America Electronics Conference), Nov. 19-20; Hotel Continental, Kansas City, Mo.

1962 Ultrasonics Symposium, Nov. 28-30; Columbia University, New York, N. Y.

First International Communications Fair, Nov. 28-Dec 2; New York Coliseum, New York, N. Y.

Now—Magnetic Glass

Now that we have become used to conductive glass, an optically transparent glass that is *ferromagnetic* at room temperatures has been produced. The new material, developed by Semi-Elements, Inc., Saxonburg, Pa., is called Ferroglass. It is expected to have important applications in thermomagnetic devices, microwave circulators, an-



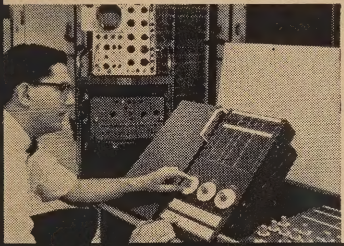
A tiny gallium arsenide crystal, the size of a pinhead, mounted near the bottom end of the black rod (seen through the circular window) generates a modulated infrared beam with an intensity up to 2,500 watts per cm².

What Job Do You Want In Electronics?

Whatever it is, Cleveland Institute can help you get it!

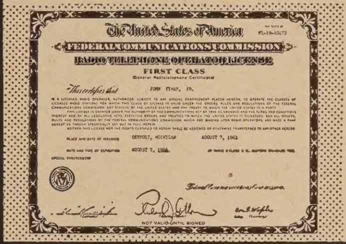
Yes, whatever your goal is in Electronics, there's a Cleveland Institute program to help you reach it *quickly* and *economically*. Here's how: Each CIE program concentrates on electronics theory as applied to the solution of practical, everyday problems. Result . . . as a Cleveland Institute student you will not only learn electronics but *develop the ability to use it!* This ability makes you eligible for any of the thousands of challenging, high-paying jobs in Electronics. Before you turn this page, select a program to suit your career objective. Then, mark your selection on the coupon below and mail it to us *today*. We will send you the complete details . . . without obligation . . . if you will act NOW!

Electronics Technology



A comprehensive program covering Automation, Communications, Computers, Industrial Controls, Television, Transistors, and preparation for a 1st Class FCC License.

First Class FCC License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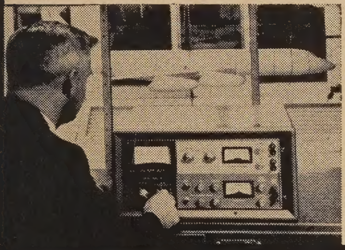
RADIO TELEPHONE OPERATOR LICENSE
FIRST CLASS

Mobile Radio, Microwave, and 2nd Class FCC preparation are just a few of the topics covered in this "compact" program . . . Carrier Telephony too, if you so desire.

Industrial Electronics & Automation



This exciting program includes many important subjects as Computers, Electronic Heating and Welding, Industrial Controls, Servomechanisms, and Solid State Devices.

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Here's an excellent studio engineering program which will get you a 1st Class FCC License and teach you all about Program Transmission and Broadcast Transmitters.

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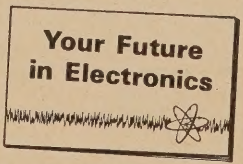

Please send FREE Career Information prepared to help me get ahead in Electronics, without further obligation.

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- ☐ Industrial Electronics
- ☐ Broadcast Engineering
- ☐ First-Class FCC License
- ☐ Electronic Communications
- ☐ ______ other

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Solid-State Throughout • Maximum Reliability

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MOST SELECTIVE — DUAL-CONVERSION SUPERHET

Release the switch — you're still on-the-air. (Don't let the silence fool you! Adjustable squelch shuts out extraneous signals for noise-free standby reception.) The sensitive receiver circuit — a dual-conversion superheterodyne — captures weakest signals, and reproduces them with crisp, clear intelligibility. No adjacent channel interference. Highest selectivity with tuned ceramic filters. Electrical interference virtually eliminated with the '510's' effective automatic noise limiter.

MOST RELIABLE — 100% SOLID-STATE DESIGN

Whether pressing or releasing the mike switch, you're controlling the most reliable, maintenance-free Citizens Band transceiver. It's completely transistorized — 18 transistors, 8 diodes. Keep it "ON" safely all day — no heat problems, no tubes to burn out and replace, lowest current drain prolongs vehicle battery life. Solid-state components absorb road punishment without damage.

MOST COMPACT—EASIEST TO INSTALL

The smallest, full-power Citizens Band transceiver is easiest to install. Its 3⅛″ height never steals leg room in a vehicle; fits smartly under the dash of the smallest foreign compact. And it can be used anywhere — vehicle, base station field, marine craft. A dual-power supply — 12VDC/110-220VAC — is built right into the Cadre '510'. Add a portable pack accessory (model 500-1) with rechargeable batteries and you have the lightest, portable 5-watt radio (9½ Lbs. with batteries) for pleasure or business.

Cadre '510' complete with dynamic microphone, set of matched Channel 11 crystals, universal mounting bracket, AC & DC cords . . . $199.95.

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tennas, transformer cores, memory devices, cryogenic control, applications in corrosive atmospheres, laser-modulation usage and applications in space equipment. It could be particularly valuable in magnetic research, where it would be desirable to be able to observe the specimens.

FERROGLASS

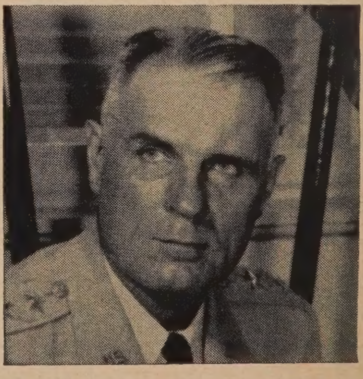
The new glass is not cheap (at least as yet). Experimental quantities are said to cost from $135 up for 1 cc.

Van Allen Warns of Danger In Electron Belt

The high-altitude nuclear test staged in the Central Pacific last summer has "increased the potential danger for man's space flights," according to Dr. James A. Van Allen. The new belt, consisting largely of high-energy electrons, is about 400 miles deep and 4,000 miles wide, stretching around the middle of the earth on the geomagnetic equator.

Maj. Gen. Stuart S. Hoff Assumes Electronics Command

Under the new reorganization program, the Army Electronics Command has been established at Fort Monmouth, N. J., with Maj. Gen. Stuart S. Hoff as commanding



(Continued on page 16)

a CREI home study program helped me become an electronics engineer”

Robert T. Blanks
Engineer, Research & Study Division,
Vitro Laboratories, Silver Spring, Md.
Division of Vitro Corporation of America.

“THROUGH A CREI HOME STUDY PROGRAM I learned the practical theory and technology I needed to become a fully-qualified engineer—not a ‘handbook’ engineer, either—and I did it while I was on the job,” says Robert T. Blanks. Today thousands of electronics personnel—engineering technicians, engineers, administrators, executives—attribute present high salaries and positions to home study of CREI Programs in Electronic Engineering Technology.

DEMAND FOR CREI-PREPARED MEN today far exceeds the supply—has exceeded the supply for many years. Designed to prepare you for responsible positions in electronics, CREI Home Study Programs are the product of 35 years of experience in advanced technica education. Aiding in their development are leading engineers and scientists from industry, government agencies and institutions of higher learning. Here Robert T. Blanks discusses CREI with Director Wayne G. Shaffer of Vitro Labs.

WHEN YOU ENROLL IN A CREI Home Study Program, you join more than 20,500 students working in electronics in all 50 states and most countries of the free world. One CREI Program helped Robert Blanks become an Electronics Engineer. Another helped Robert I. Trunnell become an Electronics Technician. While John H. Scofield—a Mathematician—is enrolled in still a different CREI Program relating mathematics to electronics. All work at Vitro Laboratories.

YOUR LIVING IS BETTER when you prepare for—and get—desired promotions through CREI Home Study. CREI alumnus Blanks is understandably proud of his home in a comfortable neighborhood. The positions of CREI-prepared men in such companies as Pan American Airways, Federal Electric Corporation, The Martin Company, Northwest Telephone Company, Mackay Radio, Florida Power and Light and many others attest to the high calibre of CREI Programs.

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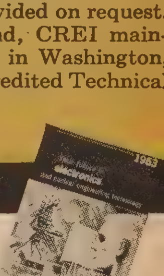

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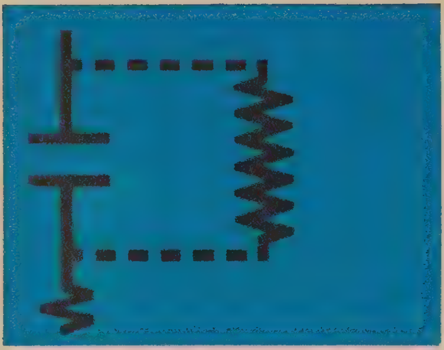

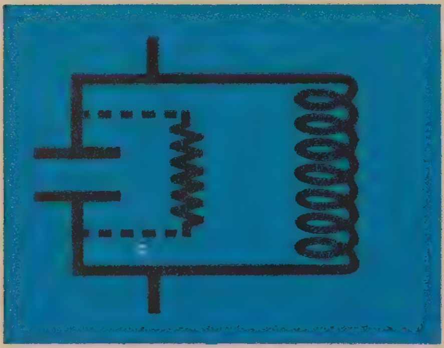

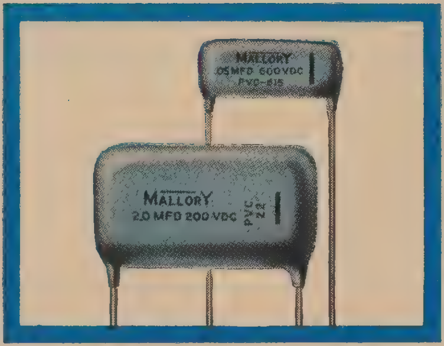

Humidity can cause serious troubles in capacitors used in many of the electronic circuits used today. Take a look at the equivalent circuit of a capacitor, and you can appreciate the source of these troubles. The D-C leakage path of a capacitor can be considered as a parallel resistance across the terminals. In a radio circuit, a capacitor with insulation resistance of as little as 25 megohms would give reasonable operation. But not in television and other sophisticated circuits.

Most television circuits have high impedance. Coupling, bypass and timing capacitors should have insulation resistance many times the circuit impedance. In a multivibrator circuit, for instance, capacitor leakage resistance alters the time constant of the timing network. In a ringing oscillator, frequency depends not only on inductance and capacitance, but also on the resistance of the capacitor leakage path.

What happens when ordinary capacitors are exposed to humidity? Sometimes there's an all-out failure. But even without a catastrophic short-out, a capacitor can begin to lose insulation resistance to the point where, in a television circuit, for instance, it's impossible to get the picture to lock in, verticals will be wavy, and the picture will bend at the top.

Our tip for the month: be sure of stable operation no matter how wet the weather, by using Mallory PVC capacitors. PVC stands for *plus value capacitor*. They're made with 100% Du Pont Mylar* dielectric. They contain no paper, no combinations of Mylar and paper, no substitutes for this most moisture-impervious of dielectrics.

PVC also stands for polyvinyl chloride . . . the flexible case on these new, blue capacitors that won't crack when you bend the leads. PVC's are exceptionally small for their ratings. You can squeeze 'em readily into crowded circuits. And they're even better in reliability, ruggedness and stability today than when we introduced them months ago.

Get Mallory PVC capacitors from your nearby Mallory distributor. He's the man to see for the best in capacitors, resistors, semiconductors, batteries . . . for *all* your component requirements.

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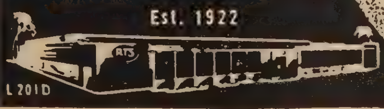

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Is the course proven?

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Is the course complete?

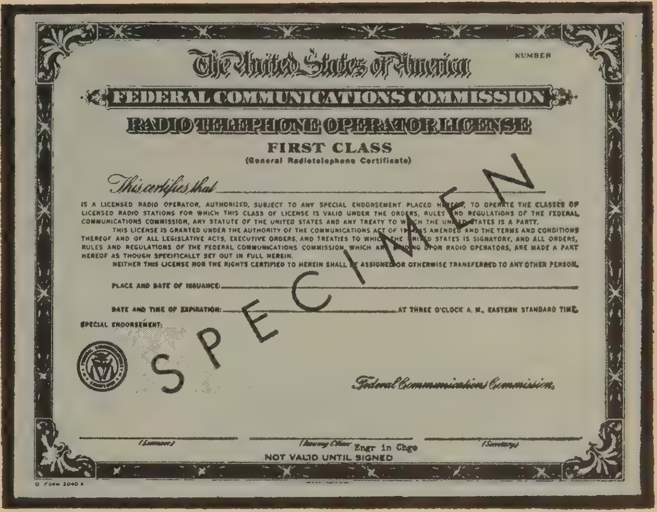
The Grantham course covers all the required subject matter completely. Even though it is planned primarily to lead directly to a first class FCC license, it does this by TEACHING you electronics.

Is the course "padded"?

The streamlined Grantham course is designed specifically to prepare you to pass certain FCC examinations. All of the instruction is presented with the FCC examinations in mind. If your main objective is an FCC license and a thorough understanding of basic electronics, you want a course that is right to the point – not a course which is "padded" to extend the length of time you're in school. The study of higher mathematics or receiver repair work is fine if your plans for the future include them, but they are not necessary to obtain an FCC license.

Is it a "coaching service"?

Some schools and individuals offer a "coaching service" in FCC license preparation. The weakness of the "coaching service" method is that it presumes the student already has a knowledge of technical radio. On the other hand, the Grantham course "begins at the beginning" and progresses in logical order from one point to another. Every subject is covered simply and in detail. The emphasis is on making the subject easy to understand. With each lesson, you receive an FCC type test so you can discover daily just which points you do not understand and clear them up as you go along.



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The United States of America

FEDERAL COMMUNICATIONS COMMISSION

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FIRST CLASS

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THIS LICENSE IS GRANTED UNDER THE AUTHORITY OF THE COMMUNICATIONS ACT OF 19[illegible] AS AMENDED AND THE TERMS AND CONDITIONS THEREOF AND OF ALL LEGISLATIVE ACTS, EXECUTIVE ORDERS, AND TREATIES TO WHICH THE UNITED STATES IS SIGNATORY, AND ALL ORDERS, RULES AND REGULATIONS OF THE FEDERAL COMMUNICATIONS COMMISSION, WHICH ARE BINDING UPON RADIO OPERATORS, ARE MADE A PART HEREOF AS THOUGH SPECIFICALLY SET OUT IN FULL HEREIN.

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DATE AND TIME OF EXPIRATION: ____________________ AT THREE O'CLOCK A. M., EASTERN STANDARD TIME.

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Federal Communications Commission.

(Licensee) (Issuing Officer) Engr in Chge (Secretary)

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Form 2040

Is the course guaranteed?

The now famous Grantham Guarantee protects your investment. When such "insurance" is available at no extra cost, why accept less?

Is it a "memory course"?

No doubt you've heard rumors about "memory courses" and "cram courses" offering "all the exact FCC questions." Ask anyone who has an FCC license if the necessary material can be memorized. Even if you had the exact exam questions and answers, it would be much more difficult to memorize this "meaningless" material than to learn to understand the subject. Choose the school that teaches you to thoroughly understand – choose Grantham School of Electronics.

THE GRANTHAM *FCC License Course in Communications Electronics is available by CORRESPONDENCE or in RESIDENT classes.*

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24-S

14,000,000 reasons why

fewer cartridges ☑ replace more models ☑ tie up less capital ☑ mean greater profits

Leading record player manufacturers—from the low-price mass producers to the well-known high fidelity manufacturers—have chosen to protect the quality of their products with Sonotone—*more than 14 million times!* That's the number of Sonotone cartridges incorporated as original equipment in the products of the nation's leading producers. And, that's also the number of *genuine* direct replacements you can make with Sonotone cartridges.

Normally, it would take a large inventory of cartridge models to provide replacements for 14 million record players. Not with Sonotone. Sonotone has so engineered its line that just a few models make it possible for you to offer a direct *genuine* Sonotone replacement to your share of 14 million potential customers. What's more, with only a few models the Sonotone line replaces the most frequently used cartridges of other manufacturers.

Sonotone has just released a series of new stereo and mono high fidelity ceramic cartridges with the same standard physical dimensions as cartridges now used in over 14,000,000 record players.

Rely on Sonotone—the line that requires fewer cartridges to replace more models. Now available in the handy 6-Pak at your distributors.

SONOTONE® CARTRIDGES

Sonotone® Corporation • Electronic Applications Division • Elmsford, New York
Cartridges • Needles • Speakers • Tape Heads • Mikes • Electron Tubes • Batteries • Hearing Aids

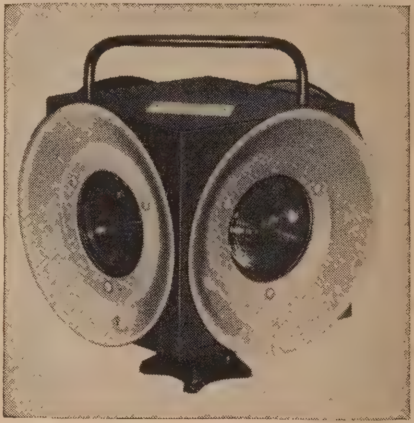
(Continued from page 10)

officer. This is one of five commands which form the Army Materiel Command and will take over most of the functions of the Army Signal Corps as well as some others, not previously handled by the Corps.

Nuclear-Powered Lamp Runs for 10 Years

A lamp that operates without batteries, bulbs or cables has been developed by the U. S. Radium Co. for use in railroad switch service.

The new switch lamp contains four mounted light sources in its housing. These are constructed of heavy radiation-resistant cerium glass windows, soldered into metal casings. Within each casing, radiation-responsive zinc sulfide phosphor is excited to the desired color and brightness by krypton 85 gas. The light sources are rugged and shock-resistant, and since they do not generate any appreciable heat or use electrical energy, they are naturally explosion-proof.



The lamps are quite compatible with present equipment, the bases being designed to fit the switch-stand tips of any railroad, and they are structurally interchangeable with present kerosene and battery-operated lamps.

Brief Briefs

Electronics may create a "technological revolution" in the legal field, due to the use of computers and other electronic devices, Reed C. Lawlor told members of the American Bar Association at the 85th Annual Meeting in San Francisco.

George Lewis, early radio pioneer, died Sept. 12. He started as radio engineer in the Signal Corps in 1910, later joining the Navy, where he became a Commander. He had been vice president of Ken-Rad and Arcturus tube companies, and later assistant vice president of ITT till retiring in 1950.

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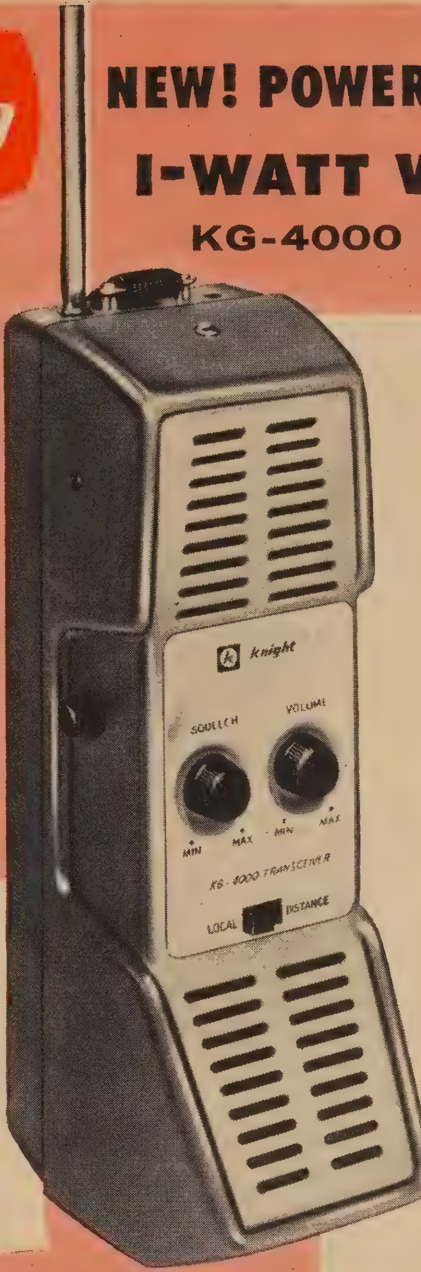

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- **Superhet Receiver with RF Stage, 2 IF's, Squelch, AVC, Noise Limiter, Push-Pull Audio Output**

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Knight-Kit is the leader again with this professional-quality transceiver kit . . . with 10 times the power of most walkie-talkies . . . with full *1-watt* RF input for reliable 2-way communication up to a 5-mile range! Superhet receiver has automatic noise limiter and variable squelch to reduce background noise and maintain speaker silence between calls. Distance-Local switch and AVC eliminate receiver distortion caused by nearby units. Includes: handy press-to-talk button; relative RF output indicator for maximum power adjustment; plug-in crystal sockets; 52" whip antenna; external-antenna jack; jack for earphone or external speaker; weather-protected built-in mike and speaker; uses 9 transistors, 3 diodes. Weighs only 32 ounces. Complete with tan high-impact Styrene case and carrying strap; wire, solder; easy instructions; FCC-permit application form. Less batteries and crystals (requires 1 transmit, 1 receive, listed below). 10⅜ x 3⅝ x 4$\frac{17}{32}$". Shpg. wt., 2½ lbs.

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83 Y 012. "C" Batteries for above (8 required), each ...... 14¢

83 Y 011. Rechargeable Battery/Charger/AC Power Supply Kit. Replaces the 8 "C" cells; may be recharged many times; charger unit permits the KG-4000 to be operated from 115 VAC while charging battery. Shpg. wt., 1 lb. Only........... **$19.95**

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20 YX 473-2. 1-Receive and 1-Transmit Crystal; specify Channel 1-22... **$5.00**

THE SPECIFICATIONS PROVE THE QUALITY AND VALUE!

Receiver: Crystal-controlled superheterodyne. Sensitivity better than 1 µv for 10 db s/n ratio. Selectivity, 6 db at 6½ kc. Image Rejection, 12 db adjacent channel, 30 db down. Audio Output, 750 µv class B push-pull.

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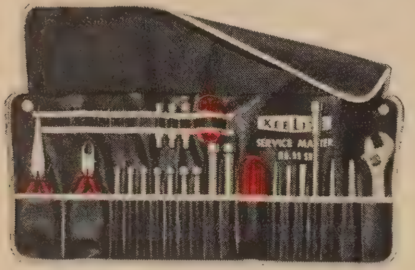
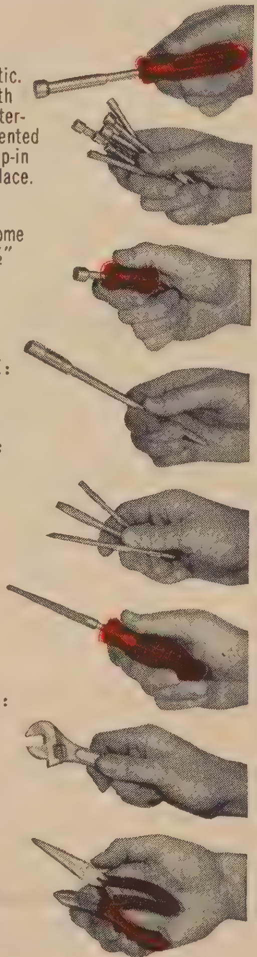


complete 23-piece kit for radio, TV, and electronic service calls



2 HANDLES: shockproof plastic. Regular 4" length ... 2" Stubby. Interchangeable. Patented spring holds snap-in tools firmly in place.

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3 STUBBY NUTDRIVERS: 1/4", 5/16", 3/8"

EXTENSION BLADE: Adds 7". Fits both handles.

3 SCREWDRIVERS: Two slotted ... 3/16", 9/32" #1 Phillips

2 REAMERS: 1/8-3/8", 1/4-1/2"

ADJUSTABLE WRENCH: 6" thin pattern, 1" opening

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DIAGONAL PLIER: "Cushion Grip", hand-honed cutting edges

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Canada: Charles W. Pointon, Ltd., Toronto, Ont.

Correspondence

Crossover-Phasing Comment

Dear Editor:

Here is a comment on crossovers and "phasing".

Basil Barbee's article "Let's Build a Crossover Network" (RADIO-ELECTRONICS, August 1962, pages 32-34) states that the high- and low-pass parts of the network are 180° out of phase due to 90° lead of one and lag of the other.

Actually, at the crossover point, the phase shift of each is 45°, not 90°, and the sum is 90°, not 180°. The two circuits never approach 180° relative phase angle. For the example used (about 2.5 kc), the phase shifts will be as follows:

f (KC)	θ low-pass lag	θ high-pass lead
0.63	14°	76°
1.25	26.5°	63.5°
2.5	45°	45°
5.0	63°	26.5°
10.0	76°	14.0°

Note the sum (actually the difference, considering that the sign of lag relative to lead is minus) of the two angles is always 90°, never 180°. A polarity reversal still leaves a 90° difference.

The polarity (not phasing) of speakers will be considerably more affected by difference of path lengths from woofer and tweeter than by phase shifts in a 90° or 6-db slope network. Even with "phasing", one must always expect some dips in response near crossover; polarity reversal will shift but not eliminate these dips. One might expect to minimize the dips by listening with both ears, or by measuring with two microphone locations, but actually no observer here has ever been able to detect "phase" by ear. The two-microphone technique is being exploited to permit indoor measurements, but the phase and polarity effect may be observed by shifting microphone locations or using two microphones.

Incorrect polarity cannot be found by listening for a null or partial cancellation at the crossover frequency; there will usually be a series of two or more such dips in sound output, and reversing polarity will result in another series, but at different frequencies. The best way, for 90° networks, is to connect both negative leads to ground. If sound pressure measuring apparatus is available, response curves may be run and examined for normal and reversed polarity (and the dips will be observed for each). Based on the idea that most people have two good ears, one may use two microphones with some means to indicate whichever is the larger, and then it will be found that polarity makes no difference. Finally, since one can't hear the difference that polarity makes when listening to a composition of frequencies, why bother? Try this with a toggle switch to reverse one speaker, and fool yourself and your friends.

PAUL W. KLIPSCH
Hope, Ark.

You Can Get Them Now!

Dear Editor:

Toward the end of your pleasant-reading News Briefs section, in the September 1962 issue, we noted the following:

"Kits for color TV receivers are expected to be on the market this fall. Two companies, Transvision and Conar, plan to produce such kits."

If you will turn to page 80 in the same issue, you will see that we are advertising our color TV kit which is being shipped to kit builders *now*. These Color TV kits are available from Transvision Electronics, Grey Oaks Ave., Yonkers, N. Y.

Thank you for your cooperation, and my compliments on your fine publication.

CHAS. GOLD
H. J. Gold Co.
New York 3, N. Y.

The Human Element

Dear Editor:

I truly appreciated Hugo Gernsback's August 1962 editorial on what computers can do. Every time I am asked what I think of electronic brains, I answer, "It's wonderful what they can do, but it will always take a human brain to plan, build and regulate them. When they break down, the human repairman will have to fix them."

PETER LEGON
Malden, Mass.

Pet Peeves

Dear Mr. Darr:

I do not like your Service Clinic column in the July 1962 issue—the one that tells us how to guess at the manufacturers of unmarked chassis and ends with the words "good hunting". Why, in the first place, do we have to do any hunting at all? Are we television repairmen, or are we research specialists? By the way, who is supposed to pay for this research? We are not endowed by a foundation.

I have always maintained that if a manufacturer goes out of his way to create mystery sets, he makes a sucker

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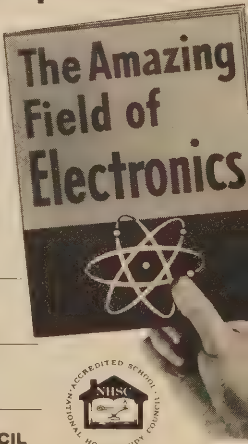

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☐ Communications

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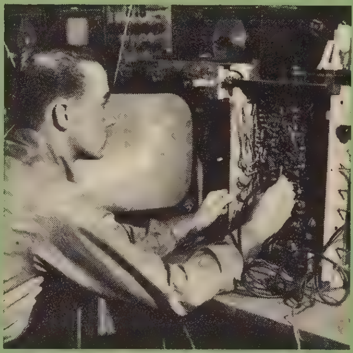

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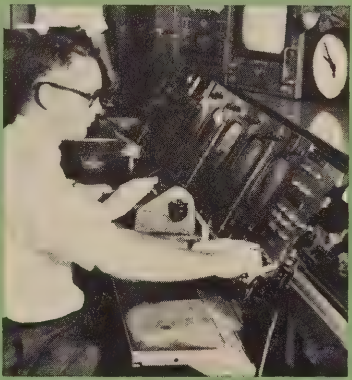

For men with Radio-TV experience who want to operate or service transmitting equipment used in broadcasting, aviation, marine, microwave, facsimile or mobile communications. A Service Technician is *required by law* to have an FCC License to work on C-Band, other transmitting equipment. From Simple Circuits to Broadcast Operation, this new NRI course trains you quickly for your Government FCC examinations.

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out of the purchaser who buys his products in good faith—no matter from what sales outlet he buys it. Yet publications seem to condone these practices. Instead of exposing the manufacturers who indulge in these activities, you all chant, "Work harder, boys! It's good for you."

I am also a consumer, and I don't like to be considered a sucker by carefully protected manufacturers.

HARRY GOLDMAN

Detroit, Mich.

[Unfortunately, the publications are in almost the same position as the service technician in identifying "orphan brand" or department-store sets.—*Editor*]

Missing—One Microphone

Dear Editor:

I find the August RADIO-ELECTRONICS contains several extraordinarily good and beautifully presented articles, for which my bouquet.

However, in one of these ("Understanding the Microphone") there is an omission. I refer to the rf-fm capacitance type microphone which has no inherent frequency limitations other than of its diaphragm. If it is made of aluminized Mylar and stretched to a very high natural frequency, or a thick, surface-aluminized disc of super-soft foam rubber, such a microphone is very close to the ideal one, as to frequency range and low distortion. The historical details and operation of this principle, not alone in microphones, but in phono pickups, electronic musical instruments, etc., were published in *IRE Transactions-Audio* for July-August, 1954.

B. F. MIESSNER

Miami Shores, Fla.

More on Electronic Ignition Systems

Dear Editor:

I read with interest Mr. H. W. Lawson's article on transistor ignition in the July issue. This is a definite improvement over the Smithy circuit using a 2D21 thyratron, though it is still complicated in comparison to what can be done with one or two transistors and a few resistors.

At any rate, I would like to tell your readers that we can supply stock heavy-duty coils in ratios of 250 to 1 and 400 to 1. These are suitable for use in single- or two-transistor circuits. While they are also suitable for use in capacitive discharge circuits, we can provide on a custom basis good-efficiency coils with ratios as high as 1,000 to 1. Such ratios permit the use of lower-voltage, less-expensive silicon controlled rectifiers.

W. F. PALMER

W. F. Plalmer Electronics Laboratories
Carlisle, Mass.

END

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Weller Hi-Speed Sabre Saw

For smooth, super-fast cutting of all kinds on speaker and record player mounting boards, cabinets, walls, etc. Makes its own starting hole for inside cuts. Never splinters or tears wood. Heavy duty, 4.8 amps. Model 88. $22.95 list

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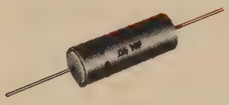

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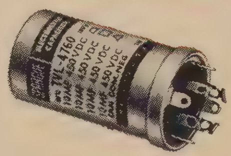
❷ DIFILM® ORANGE DROP® DIPPED TUBULAR CAPACITORS

Especially made for exact, original replacement of radial-lead tubulars. Dual dielectric combines the best features of both polyester film and special capacitor tissue. Exclusive HCX® solid impregnant—no oil to leak, no wax to drip. Double dipped in bright orange epoxy resin to beat heat and humidity.

❸ TWIST-LOK® ELECTROLYTIC CAPACITORS



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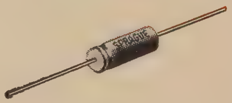

Ultra-tiny size for use in transistorized equipment. High degree of reliability at reasonable price. All-welded construction—no pressure joints to cause "open" circuits. Withstand temperatures to 85°C (185°F). Hermetically sealed. Extremely low leakage current. Designed for long shelf life—particularly important in sets used only part of the year.

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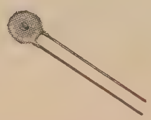

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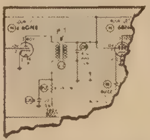

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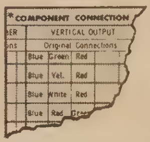
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Exact Terminal Connections are indicated—no need for trial-and-error methods—a real time-saving feature.

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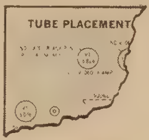
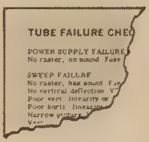
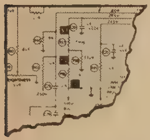
Field Servicing Notes spell out locations of adjustments for speedy "in home" servicing. Saves time spent in hunting for hidden adjustments.


TUBE PLACEMENT

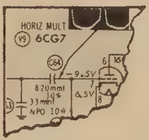
Tube Location Guide enables you to locate and replace proper tubes in seconds—a big time-saver on most repair jobs.


TUBE FAILURE CHE
POWER SUPPLY FAILURE
SWEEP FAILURE

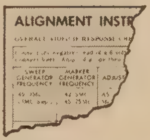
Tube Failure Check Charts spell out probable tubes responsible for failure—no need to waste time studying circuitry.



Clear Parts Symbols with values and associated information are shown plainly on the schematic—no time wasted in cross-reference "look-up."


HORIZ MULT
V9 6CG7
C64
820mmf
NPO

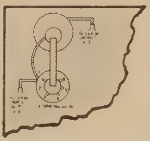
Waveform actual photos are shown on schematic for quick comparison of patterns on your scope. No time wasted in guesswork.


ALIGNMENT INSTR

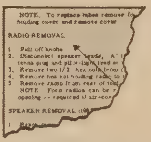
Unique Alignment System eliminates guessing; you get complete instructions with response curves, how to connect test equipment, proper adjustment sequence.

C14
C16
C17
C13
C10

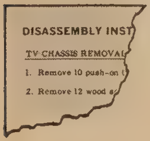
Full Photo Coverage of the actual equipment makes identification of all components and wiring easy—you can see everything.



Terminal Identification saves you time; transformer and coil terminals quickly identified by color code or basing diagram shown on schematic.


RADIO REMOVAL
SPEAKER REMOVAL

Auto Radio Removal instructions show you step-by-step procedure for removal of even the most complicated models—a big time-saver.


DISASSEMBLY INST
TV CHASSIS REMOVAL
1. Remove 10 push-on
2. Remove 12 wood

Disassembly Instructions, step-by-step, help you remove difficult chassis, subchassis, and assemblies in minutes.

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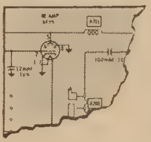
HOWARD W.

Dial Cord Stringing instructions save you up to an hour or more of time and headaches on a single job.



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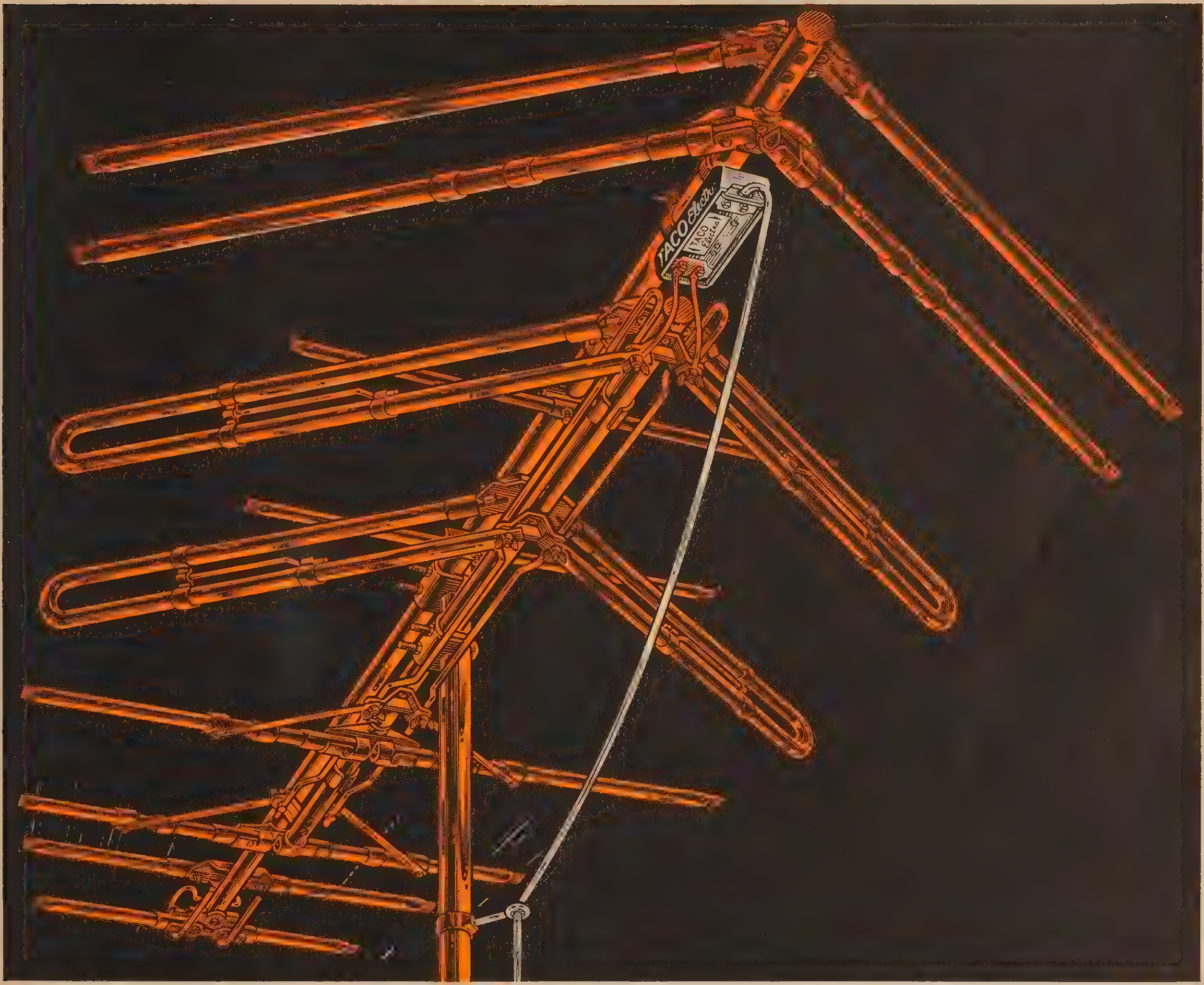

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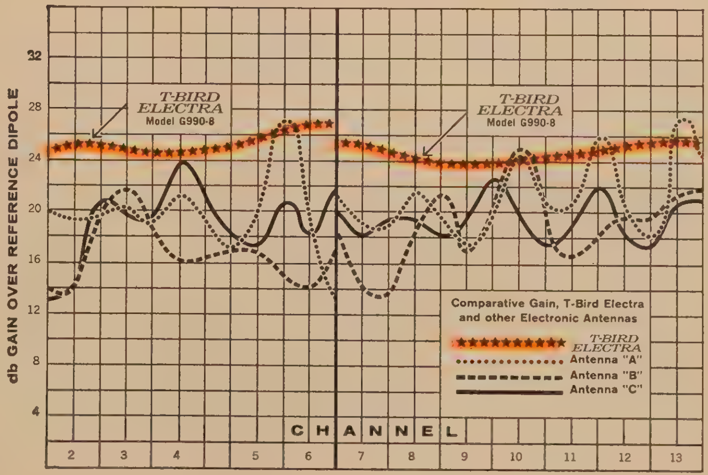

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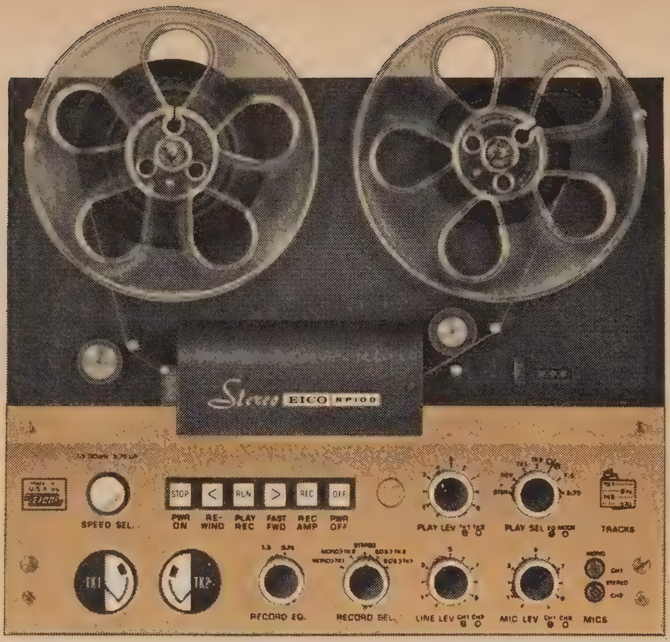

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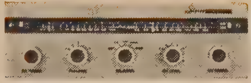

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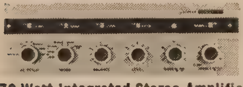
Includes Metal Cover and FET



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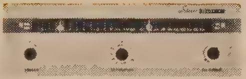

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Another brilliant example of EICO's no-compromise engineering, the new EICO ST97 combines the features of station-monitor quality and fringe-area reception capabilities with exceptional ease of assembly for the kit-builder. No test or alignment instruments are needed. The two most critical sections, the front-end and the 4-IF stage circuit board, are entirely pre-wired and pre-aligned for best performance on weak signals (fringe area reception). The front-end is drift-free even with AFC defeated. The four IF stages and 1MC-wide ratio detector achieve perfect limiting, full-spectrum flat response, very low distortion, and outstanding capture ratio. The 10-stage stereo demodulator—EICO's famous zero-phase-shift filterless detection circuit (pat. pend.)—copes successfully with all the problems of high fidelity FM stereo demodulation and delivers utterly clean stereo outputs. Excellent sensitivity, selectivity, stability, separation and clean signal add up to superb fringe-area reception. The automatic stereo indicator and station tuning indicator travel in tandem on twin slide-rule dials. **Antenna Input:** 300 ohms balanced. **IHFM Usable Sensitivity:** 3μV (30 db quieting), 1.5μV for 20db quieting. **Sensitivity for phase-locking (synchronization) in stereo:** 2.5μV. **Full Limiting Sensitivity:** 10μV. **IF Bandwidth:** 280kc at 6 db points. **Ratio Detector Bandwidth:** 1mc p-p separation. **Audio Bandwidth at FM Detector:** Flat to 53kc discounting pre-emphasis. **IHFM Signal-to-Noise Ratio:** —55db. **IHFM Harmonic Distortion:** 0.6%. **Stereo Harmonic Distortion:** less than 1.5%*. **IHFM IM Distortion:** 0.1%. **Output Audio Frequency Response:** ±1db 20cps-15kc. **IHFM Capture Ratio:** 3db. **Channel Separation:** 30db. **Audio Output:** 0.8 volt. **Output Impedance:** low impedance cathode followers. **Controls:** Power, Separation, FM Tuning, Stereo-Mono, AFC-Defeat.

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Radio-Electronics
Hugo Gernsback, Editor-in-Chief

TELSTAR-I RESULTS

. . . One of the Most Complex Electronic Space Devices Scores . . .

SINCE its successful launching on July 10, 1962, Telstar I has surpassed the fondest hopes of its designers. At the moment its telemetry indicates perfect working of all its electronic-mechanical instrumentation. Although Telstar could probably stay in orbit for 200 years, its electronic equipment will be automatically shut off after about two years, to clear the frequencies for other Telstars.

As described in RADIO-ELECTRONICS in September, 1962, its ball-shaped dimensions are about 37 inches diameter (axial), 34 inches equatorial. Its total space weight is 170 (earth) pounds. Its outer surface carries 72 flat facets, 60 of which have a total of 3600 solar cells which continuously recharge 19 nickel-cadmium cells when in direct sunlight. On three facets are mirrors to reflect the sunlight to earth for optical tracking.

Telstar obtains all its power from the sun via its solar cells, at the rate of 13.5 watts output. This may decrease, according to its builders, to 11.5 watts because of the effects and the impact of various charged particles.

Telstar's orbit is quite elliptical—purposely so. At its highest, it soars to 3501.8 statute miles (apogee); at its lowest it is 593.4 miles (perigee). Its period of revolution around the earth is 157.8 minutes.

Around the satellite's equator it carries one receiving and one transmitting antenna for communications and transmission of a precision tracking signal. Above its axis there is a wire-helix antenna for telemetry, command and continuous beacon circuits.

Telstar I was designed chiefly as an orbiting *experimental* broadband microwave space relay station. It receives earth radio signals at a frequency of 6390 megacycles, amplifies these and retransmits them back to earth on 4170 mc. It can do so only in straight lines, however, because of the curvature of the earth, which limits its total range. It must be "visible" to both sending and receiving stations *simultaneously*. The very weak signals received by Telstar are first transformed to a 90 mc intermediate frequency, then amplified about a million times, then transformed to 4170 mc. A traveling wave tube provides final amplification, an additional 5000 times. *Total amplification is about 2 billion times.* When retransmitted to earth, the signal has a power of 2¼ watts.

Telstar is pressurized internally with an atmosphere of carbon dioxide (CO_2). Its special instruments for that purpose, after many weeks, show that meteorites have not pierced Telstar's skin so far. The internal temperature *averages* 75° F. This drops 40° more or less when Telstar dips into the Earth's shadow, down to about 35° F. The outside skin temperature of the station varies from 18° F. in the shadow to 48° F. in the sun.

The greatest enemy of Telstar thus far is not micrometeorites, or even small meteorites, but radiation. This may be of solar origin, such as solar X-rays, ultraviolet rays, etc., or Van Allen belt charged particle radiation, as well as possible damage from the artificial new belt caused by last summer's US nuclear explosions in space. Not protected by the Earth's vast blanket of atmosphere, Telstar gravitates in space, a naked target for the all-powerful cosmic rays as well.

Fully aware of this, its designers planned a number of experiments to measure the effects of radiation on electronic gear. Telstar's outer skin carries six differentially shielded silicon transistors, all radiation-sensitive. It appears that space radiation has progressively weakened these transistors. Thus the current gain of the least heavily shielded transistor decreased by a factor of 8.

Furthermore, solar cells deteriorate steadily by radiation bombardment. It appears that the *least shielded* solar cells, protected only by 20 mils of synthetic sapphire, decreased by about 10% current output after two weeks in space. For those protected by 25- and 30-mil shields of sapphire, the current decrease was only about 5%.

Electronic people will not be too surprised that inside Telstar's small body, aside from its voluminous electronic and other gear, there are 1064 transistors and 1464 diodes! Surprisingly enough, there is only one lone vacuum tube on board! This is the foot-long traveling wave tube already mentioned. Its inventors were Drs. John R. Pierce and Jack A. Morton of Bell Telephone Laboratories, Inc.

Bell Telephone Laboratories was responsible for the design and construction of Telstar I. The American Telegraph and Telephone Co. paid the entire cost of the Telstar project, including a fee of $3 million paid to National Aeronautics and Space Administration for launching it into orbit.

Inasmuch as a single satellite cannot give continuous worldwide service, it will be necessary to put up a multiplicity of Telstars, so there will always be several above the horizon. This makes for a minimum of 30 to 50 communication satellites within 10 years.

However, once we have sufficiently powerful rockets to launch them, future, more sophisticated Telstars can be elevated to a height of 22,238 miles above the equator. At this height they will revolve with the speed of the earth and will hover, apparently stationary, over the circumference of the earth.* At this height, we require only 3 Telstars. However, at such an elevation we meet with a disagreeable time lag because it takes a signal 0.3 second to travel both ways. In a 2-way telephone conversation there would be a 0.6 second lag between speaking and hearing the reply. This might be annoying in telephone conversations. The time lag however would not affect TV transmission and reception.

A compromise of 4 or 5 Telstars lifted to a height of about 10,000 miles, as pointed out in our March, 1958 editorial, might be a solution. This would make it possible to carry a traffic of over 10,000 simultaneous telephone conversations plus other traffic, such as world-wide television and various other requirements. It probably can be accomplished before 1975, in the writer's estimation.

—H.G.

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* See also editorial "Satellite Electronics," March 1958, RADIO-ELECTRONICS, page 33. Also "Future Space Traffic," November 1960, page 33.

HOW GOOD IS RADAR JAMMING?

Can we block enemy radar?

By JORDAN McQUAY

MODERN RADAR IS USED WIDELY IN BOTH military and industrial applications to detect and locate aircraft, ships and other objects in the air, on land and on the sea. Radar is a basic military weapon—useful in wartime as an aid to combat, in peacetime for defense.

The development of every new military weapon has produced, in turn, a counterweapon or defensive measure. Just as the use of gas resulted in the gas mask, just as the heavy bomber established the need for radar, radar *countermeasures* evolved against radar itself.

The accuracy, sensitivity and other unique attributes of radar were described in the June and July 1960 issues of RADIO-ELECTRONICS. And by the very nature of its operation, radar is extremely vulnerable to interference and jamming. The extreme sensitivity and other characteristics of modern radar can be turned against it by adroit radar countermeasures. We can expect these countermeasures to be used against our own radar installations by an enemy. Similarly, the United States is ready to administer the same treatment to any potential enemy.

The "treatment" may include any of several kinds of countermeasures. Most frequently used is radar jamming —the deliberate transmission of signals intended to interfere with the operation of enemy radar. The purpose is to nullify or at least minimize their effectiveness by obscuring or confusing radar scope displays and thus eliminating or distorting the reception of intelligence.

The first classic example of large-scale radar jamming took place in early 1942 when three German warships escaped from Brest, moved through the English Channel and reached the safety of northern ports. Nearly a hundred German jamming stations in France so effectively blinded British coastal defense radars that they could not detect the warships passing through waters under British surveillance.

There was limited jamming during the Korean war. And this specialized electronic warfare can be expected during any future limited or global war. Although not always completely successful, it is a potent counterweapon.

Weaknesses and antidotes

Deliberate radar jamming and countermeasures are potentially successful because of certain characteristics and inherent weaknesses of radar.

Chiefly these are its extreme sensitivity to returning rf signals, the visual nature of these results on radar display scopes, and the inability of radar to distinguish the precise nature or number of relatively small targets.

A radar transmits recurring pulses of tremendous magnitude—often several megawatts of peak power. These pulses travel long distances before they impinge on a target or other object and are reflected to the radar. Often they return with only a few millivolts, or even microvolts, of input power. Very sensitive rf receivers detect these weak "echoes." They *also* pick up interfering, jamming, noise and other signals (at the frequency of operation) in the path of the radar antenna. Thus, we must carefully discriminate between the wanted signal from a distant target and extraneous and jamming signals from a multitude of other sources.

An operating radar is its own best advertisement, continually blasting the air with its operational presence. It cannot function secretively, and thus betrays its existence as well as its frequency and other characteristics (by electronic surveillance and analysis), its direction (by radio direction finding) and its location (by triangulation with two or more rdf stations). If the radar is not driven off the air by enemy jamming, it may be blasted off the earth by enemy bombers.

To minimize some of these inherent weaknesses, modern radars incorporate a variety of advanced-design electronics stages and circuitry.

Some radars have provisions for varying or slightly changing the operating frequency of the transmitter. This is invariably used with cavity magnetrons. The frequency of received signals can be varied by a change in the tuning of the local oscillator of the superheterodyne radar receiver. High- and low-pass filters are used in the rf and video stages of most receivers to screen and remove unwanted or interfering signals. Both the duration and the frequency of transmitted pulses can be varied. A change in prf (pulse recurrence frequency) is being widely used to "lose" jamming signals that are synchronized with the radar. Most modern installations are also equipped with "black-box" AJ (anti-jamming) circuits. When they are operating, the normal display on the radar scope is divided into a number of magnified segments—to permit better visual discrimination between wanted and unwanted signals.

But despite these technological advances, all types of modern radar are susceptible, in greater or lesser degree, to many types of jamming and other countermeasures.

Principal types of jamming may be described in terms of the visual appearance of the two basic types of radar displays—the A-scope and the PPI-scope. There are countless varieties of these principal patterns, the nature or variety depending upon the jamming. Through many of these jamming patterns, however, the target signal can still be observed by operators with patience.

A-scope effects

Visual effects of several types of jamming viewed on a radar A-scope are shown in Fig. 1. All synthesized effects are obtained with the same radar and scope, and the same target.

A normal A-scope presentation, without jamming, is shown in Fig. 1-a. At the left is the radar transmitter pulse marking the start of measurement of distance to a target, at the right, the target at a distance along the base line. Minor deflections along the base line—known as "grass" or "clutter"—are caused by atmospheric noise and other *unintentional* electronic interference of an external nature.

Occasional pulses which may

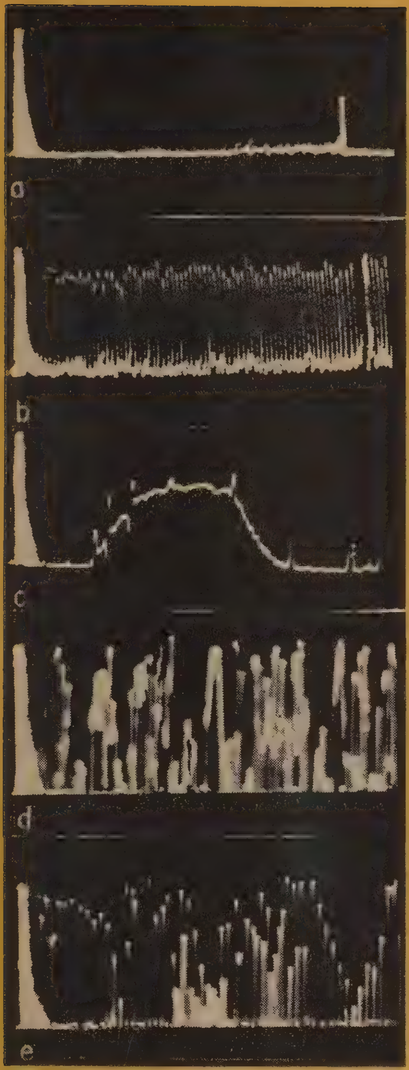


Fig. 1—Effects of jamming on radar A-scope: a—Normal scope, no jamming. b—CW pulsed jamming. c—FM jamming. d—FM plus noise jamming. e—AM plus noise jamming.

sometimes move quickly along the base line are known as "rabbits" and are frequently too swift to photograph. This type of intermittent interference is caused by a jammer or by any rf transmitter that is not synchronized with the radar.

When a jammer is using CW pulsed modulation, the A-scope effect (Fig. 1-b) is known as "railings." If these appear stationary, the jammer and the radar are synchronized. Any movement of the "railings" along the base line indicates a difference in prf between jammer and radar. With a little practice, a radar operator can easily read through the "railings" and detect and locate the target.

An AM jamming signal usually produces steep-sided visual effects on an A-scope. An FM signal usually produces sloping waves or "humps."

In a typical instance of FM jamming (Fig. 1-c) the resulting "hump" distorts a portion of the base line. This distortion is caused by frequency sweeps greater than the response curve of the receiver. The undistorted part of the base line is linear and unaffected. When all of the base line is disturbed and distorted, the frequencies of the FM jamming signal are within the response curve of the radar receiver. If the FM jammer is synchronized with the radar, the "hump" effect will be stationary and the target difficult to detect. If the jammer and radar are not synchronized, the "hump" effect will move along the base line, permitting an occasional glimpse of the target.

The most effective jamming signals are *combinations* of FM with noise (Fig. 1-d) or pulsed AM with noise (Fig. 1-e). The addition of electronic noise produces a highly complex signal, which almost completely masks the target signal. With much patience, a radar operator can detect and locate a target signal in the confusion on his scope. But usually this type of jamming is almost 100% effective.

PPI-scope effects

The effect of radar jamming signals on a PPI-scope has a different appearance, mainly because a PPI-scope presents target azimuth or direction as well as target distance. The rotating base line is synchronized with the radar antenna, and both revolve several times a minute. As a result, PPI-scope effects of radar jamming are frequently multicircular, often very complex and usually symmetrical. Fixed patterns indicate the jammer is synchronized with the radar; moving patterns, a difference between their prf's. In fast-sweep PPI-scopes, the target is frequently obscured by the circular maze of confusion.

A normal PPI-scope presentation, without jamming, is shown in Fig. 2.

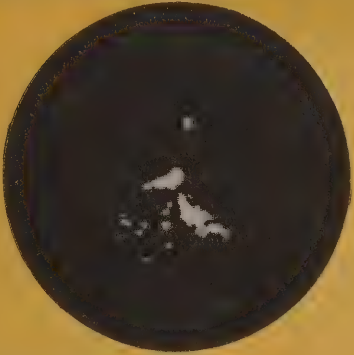


Fig. 2 — Normal PPI-scope (without jamming).

The dots and splotches indicate recurring signals from targets and objects within range of the radar, represented at the center of the PPI-scope.

Four examples of the effect of CW pulsed jamming are shown in Fig. 3—the CW pulses vary in width from extremely narrow to very broad. A broad CW pulse means that the jammer is transmitting an excessive amount of average power, producing more interference on the PPI-scope, but at the expense of greater output power at the jammer.

Four effects of CW pulsed jamming of fixed pulse duration, but with four different prf's, are shown in Fig. 4.

Examples of the effects of FM jamming, at four carrier frequencies, are shown in Fig. 5. Harmonic relations are responsible for the exceedingly complex patterns viewed on a PPI-scope. By further varying the prf, even more complicated designs appear on the scope.

Jamming equipment

Jammers are of three broad types: ground based, shipborne or airborne.

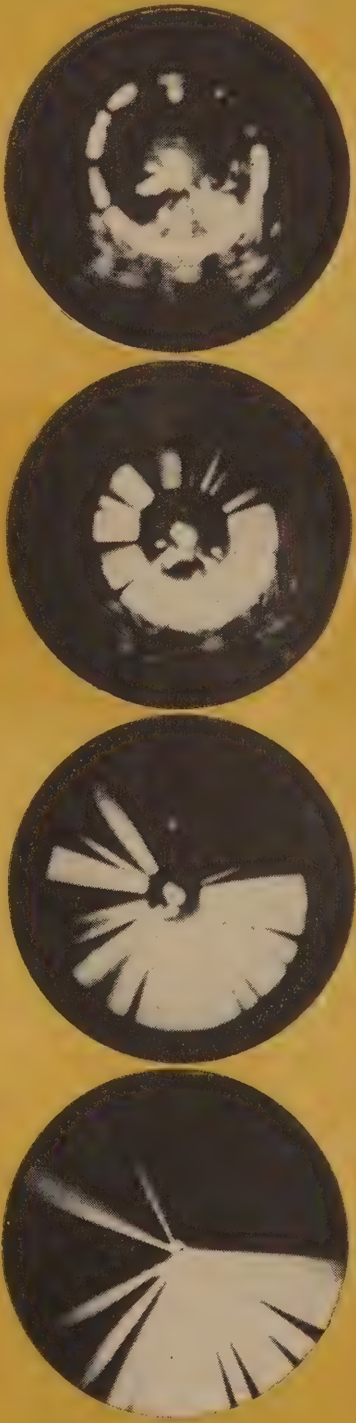


Fig. 3—Effect of CW pulsed jamming on PPI-scope. Top to bottom shows increase in pulse width.

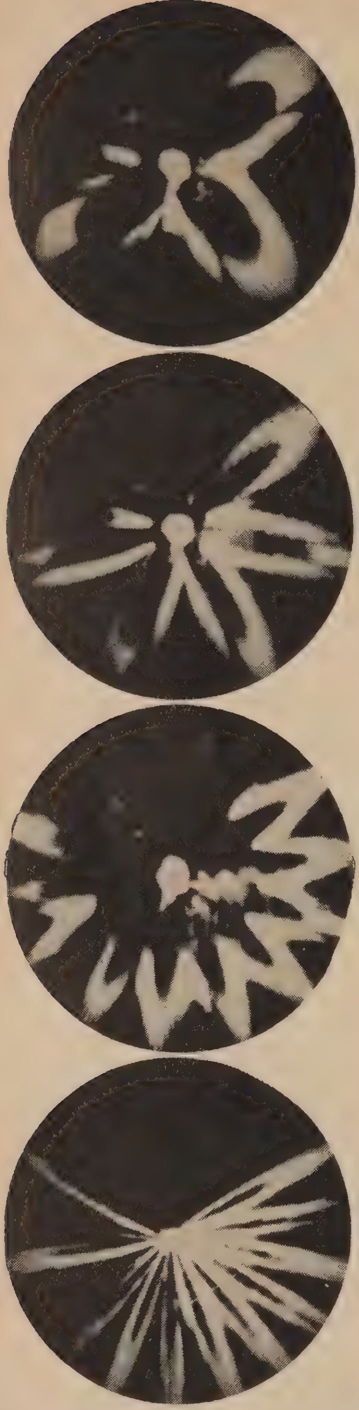


Fig. 4—Effect of CW pulsed jamming on PPI-scope. Top to bottom shows increase of prf of jammer with respect to radar.

All modern ones are capable of generating and transmitting a variety of jamming signals at any specified operating frequency.

While technical details of current jammers are classified as military information, some general data on several typical jammers can be revealed. Newer models constitute improvements in sophistication — primarily the greater variety of intermixed AM/noise and FM/noise signals that can be generated and broadcast.

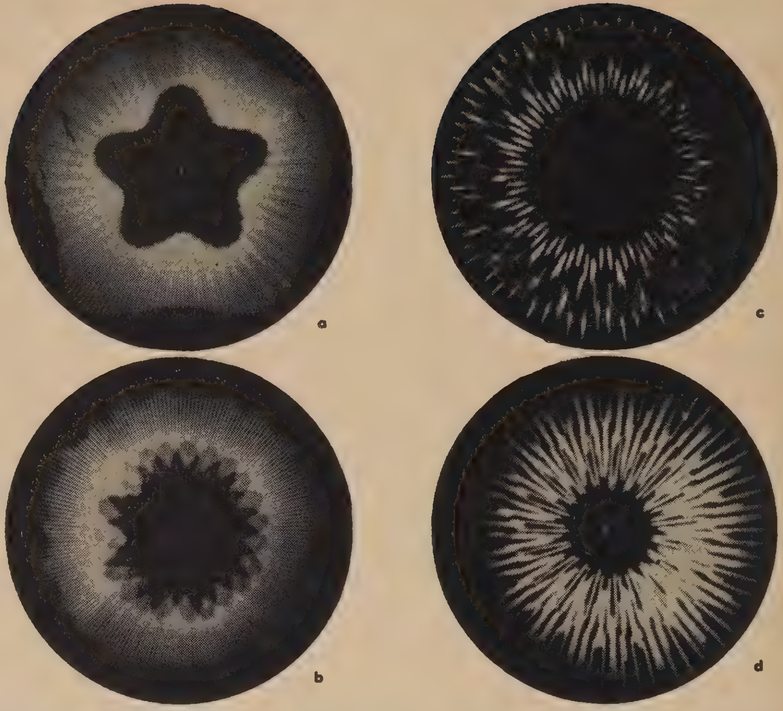


Fig. 5—Effect of FM jamming on PPI-scope. (a) through (d) shows consecutive increases in frequency.

A typical ground-based jammer (Fig. 6), the TDY-2, has been used extensively by both the Army and Navy. The transmitter's final stage uses a CW cavity magnetron.

An airborne jammer (Fig. 7), the AN/APT-4, also uses a cavity magnetron. The omnidirectional wide-band antenna is characteristic of many types of jammers.

Special-purpose jammers include one that is essentially a miniaturized transmitter, which can be dropped by parachute, suspended from a balloon, or launched in the vicinity of an enemy radar by a rocket or artillery. Battery-powered, it is small in size and weight, and equipped with a self-destruction mechanism to prevent its falling into enemy hands.

Passive devices

All the jamming equipment and techniques so far described are known as *active* countermeasures. When used against enemy radar, they are easily controlled and involve electronic components and circuitry.

Another important category, the

Fig. 6 — Typical ground-based jammer being assembled for Army and Navy.

General Electric

passive countermeasures, require no equipment or circuitry and use the transmitted pulses of an enemy radar to counteract it. This is done with rf *reflectors,* especially designed to produce maximum "echoes" at the enemy radar.

There are two types of passive countermeasures: *chaff* and *rope.*

Chaff, also known as *window,* consists of literally thousands of thin strips of lightweight reflecting material—tin foil, aluminum foil or metallic-coated paper—about ⅜ inch wide. The length of each strip depends upon the operating frequency of the enemy radar to be jammed. A microwave radar requires strips about 1 inch long; lower radar frequencies require longer strips.

Bundles of precut chaff are dropped by aircraft at high altitudes, or they may be fired into space by small rockets (Fig. 8). The bundles quickly separate and disperse the many reflective strips—which then float gently down through a predetermined airspace area.

When pulses from an enemy radar strike the moving mass of chaff, "echoes" returning to the radar indicate hundreds of reflections. Since a radar cannot distinguish differences in the size of small objects, the effect of chaff on a PPI-scope (Fig. 9) is that of hundreds of aircraft—a massive deception.

While the effect may last for only 30 minutes, this is often enough time to confuse the enemy or to synchronize some diversionary tactic.

Chaff is cut to about one-half the wavelength of the radar to be jammed; and has an effective bandwidth approximately 15% of center frequency.

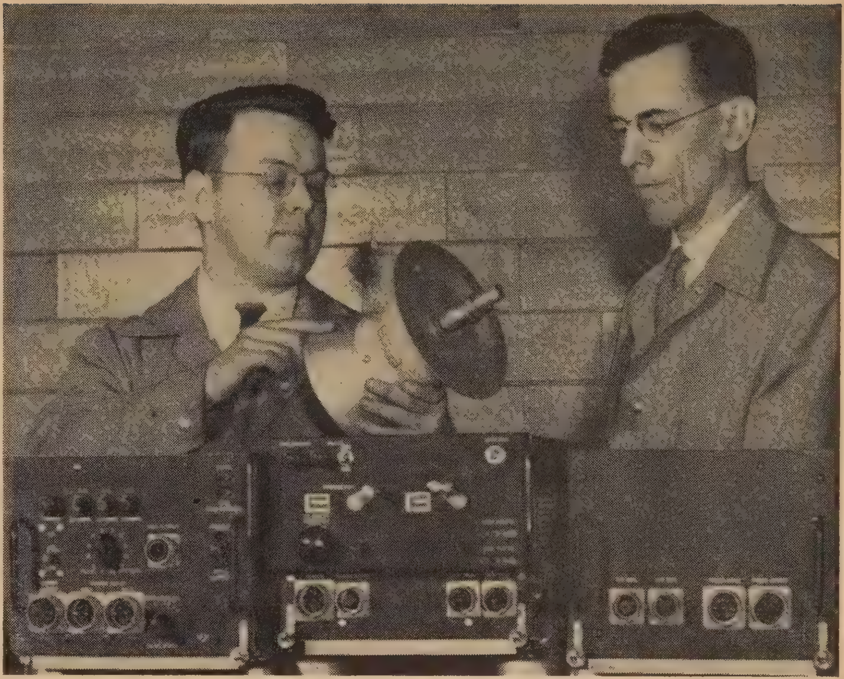
Rope consists of bundles of long pieces of metallic tape, often as long as a hundred feet. Used against low-frequency radars, it produces a deceptive effect similar to chaff. Rope is essentially an untuned reflector and is used best against radars operating at frequencies below 300 mc.

The principal disadvantages of all passive countermeasures are that they fall rapidly, drift with prevailing wind and quickly disperse due to falling and drifting in space.

Using countermeasures

Tactical use of radar countermeasures requires a good deal of military preplanning and coordination. Long before a ground-based or shipborne jammer goes into action or before chaff is dropped by aircraft, there is electronics activity by technical intelligence teams and other groups concerned with the success of the operation.

The *search* phase of radar countermeasures involves the location and continuous monitoring of enemy radar. Established as near the enemy as possible, intelligence teams maintain an electronic surveillance of all enemy transmissions. Results—operating frequency, prf, pulse duration, other technical characteristics — are carefully measured, recorded and analyzed. Geographical location of all enemy radars is determined by precision rdf equipment. Supplementary data are collected by special aircraft—known as *ferrets* or *electronic snoopers* — equipped with receiving and recording gear for close contacts with enemy radars.



General Electric

Fig. 7—Typical airborne jammer ready for installation and use by the Air Force.

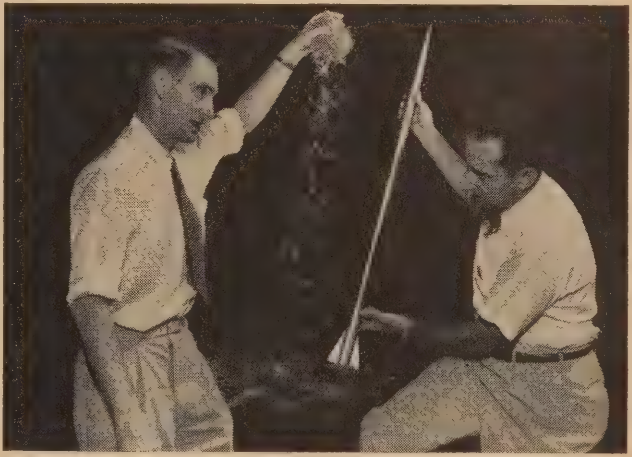
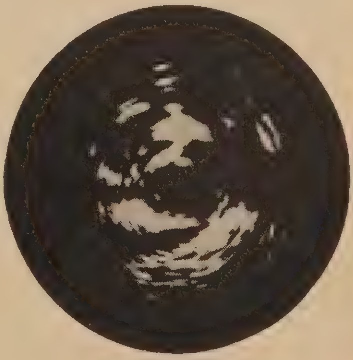


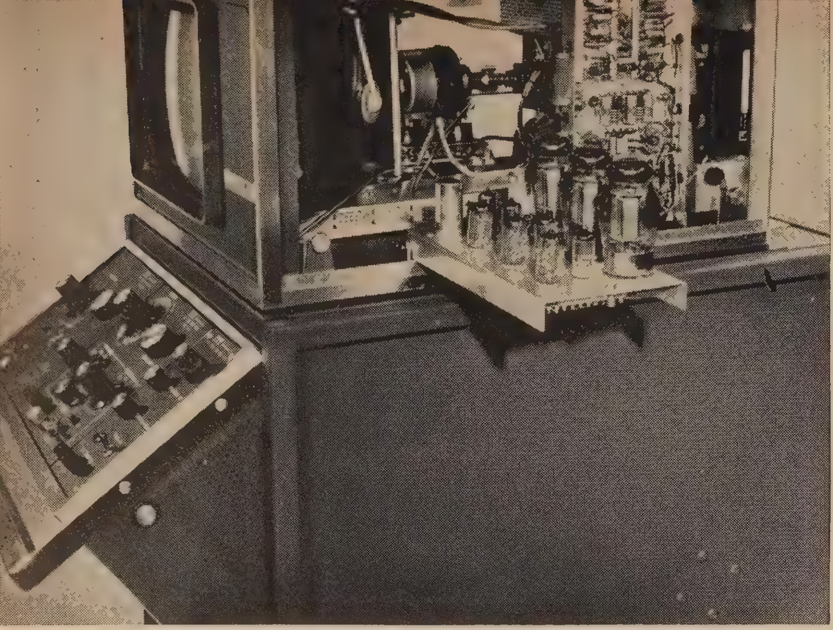
Fig. 8 — High-frequency chaff which is dispensed by small rockets.
U. S. Army

Based on all technical data collected during the *search* phase, plans are completed for the most effective type of countermeasures to be used against the enemy sites. Appropriate jamming equipment is set up at key sites. But the jamming transmitters are not fired up, not even tested with dummy antennas.

There is a period of waiting—until the countermeasures operation can be coordinated with a major military operation against the enemy. Then, at H-hour, the jamming transmitters open up with a barrage of composite jamming signals directed against the enemy radars. Perhaps at the same time, the Air Force is dropping chaff in the skies above the invasion area. Surprise is an important factor in the success of radar countermeasures. Confusion is introduced suddenly and unexpectedly to assure maximum effect. END

Fig. 9—Effect of chaff on PPI-scope.





COVER STORY

Now—A Large-Screen Scope With Wide Frequency Range

Sampling gives a 14-inch scope usable response from zero to 5 mc

OSCILLOSCOPE DESIGN ENGINEERS HAVE been faced with a paradox. Large-screen scopes could find many uses, in such applications as classroom demonstrations, production-line testing, readout devices for analog computers and for multi-channel data display. Yet a large-screen scope must be magnetically deflected—the narrow deflection angle possible to electrostatic deflection limits it to smaller C-R tube sizes. But the inductance of a magnetic deflection yoke delays the rise time of an applied voltage and so will display faithfully only the lowest-frequency waves. Above about 15 kc it becomes almost useless. Yet so valuable is the large screen that there has been since 1955 a small but steady market for magnetic scopes, to find limited use in the lower frequencies.

When requested to supply a 14-inch scope flat to 5 mc, engineers of International Telephone & Telegraph's Co.'s Industrial Products Div. (San Fernando, Calif.) found it necessary either to make magnetic deflection work at high frequencies or to devise an electrostatic-deflection system that would work with a large tube. Magnetic deflection, they believed, was the practical answer, and they achieved a breakthrough by using a technique heretofore used only on the highest-frequency scopes—that of *sampling* (See "About Those Super-Scopes," RADIO-ELECTRONICS, March 1961).

Sampling is sensing the waveform with components that are not frequency-sensitive. Diodes that respond in tenths of microseconds are used. A short *gating* impulse turns the diode on, and the instantaneous amplitude of the signal at that instant charges a storage capacitor through the diode. At the end of the gating impulse, the charge on the capacitor is proportional to the instantaneous amplitude of the signal. The gating circuit timing is controlled by the frequency being measured. One sample of each cycle of the signal wave is taken, each sample being a little later in the cycle than the preceding one. If a wave were to be sampled at 18 points, for example, an 18-mc signal, sampled once per cycle (Fig. 1-a) could be displayed on a scope sweeping at 500 kc (Fig. 1-b). Persistence of the screen phosphor and of human vision make the string of dots look like a continuous curve.

Existing sampling scopes, while able to display extremely high-frequency waveforms, were limited to small C-R tubes. And because they took only one sample of the wave per cycle, they could not be used for the low-frequency waveforms which had been considered the natural field of the large-screen scope. They just couldn't plot a large enough number of points to represent the wave correctly.

The ITT breakthrough that made full-screen magnetic deflection possible both at 5 mc and at frequencies going right down to zero was to make the sampling process entirely independent of the wave being sampled.

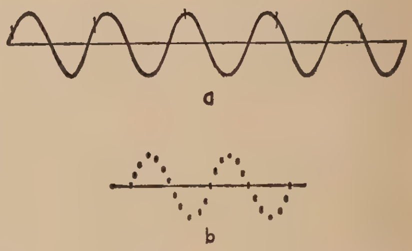
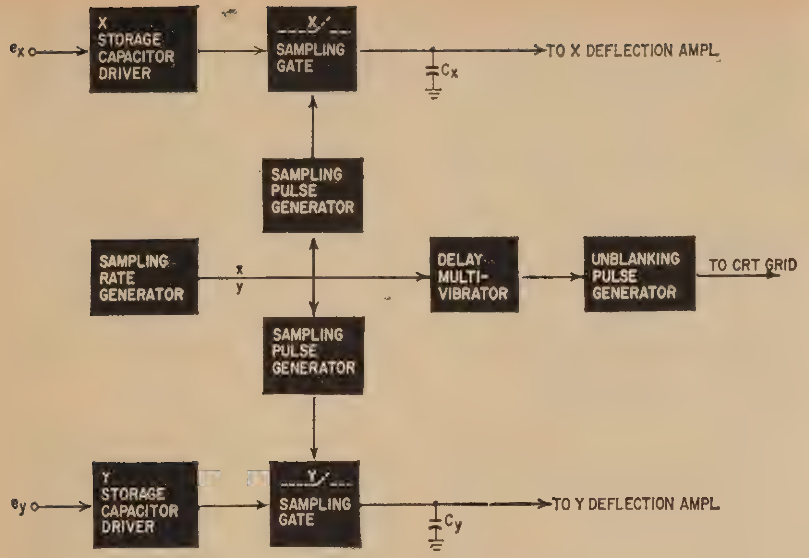


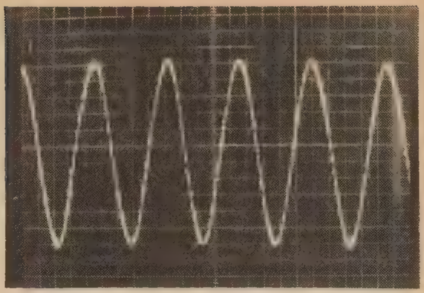
Fig. 1-a —How the ordinary sampling scope samples a high-frequency waveform. Fig. 1-b —The waveform of 1-a as reproduced on the screen at a much lower frequency.

The operation can be understood from Fig. 2, a simplified block diagram. Circuitry for the horizontal (x) and vertical (y) inputs is identical, to give the scope greater flexibilty. Each input consists of the driver stage which converts the input voltage signal to a current sufficient to charge the storage capacitor. The output from the current driver is fed to the sampling gate, which is normally an open circuit. When the sampling pulse generator is activated (once every 20 microseconds) the sampling gate connects the input current driver to the storage capacitor (Cx and Cy in the diagram). The storage capacitor now assumes a charge proportional to the value of the incoming signal and follows its variations so long as the gate remains open. When the gate closes, the instantaneous change on the storage capacitor is trapped and remains static un-

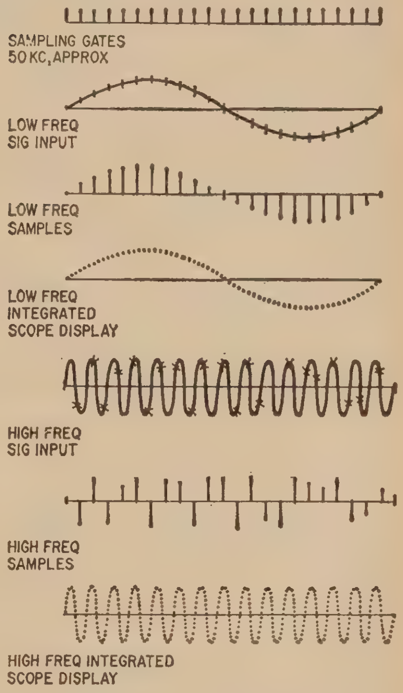


e_x
X STORAGE CAPACITOR DRIVER
X
SAMPLING GATE
C_x
TO X DEFLECTION AMPL
SAMPLING PULSE GENERATOR
SAMPLING RATE GENERATOR
x
y
DELAY MULTI-VIBRATOR
UNBLANKING PULSE GENERATOR
TO CRT GRID
SAMPLING PULSE GENERATOR
e_y
Y STORAGE CAPACITOR DRIVER
Y
SAMPLING GATE
C_y
TO Y DEFLECTION AMPL

Fig. 2—Simplified block diagram of inputs to ITT LS-421 scope.



Sample waveform displayed on the LS-421 large-screen scope.



SAMPLING GATES 50 KC, APPROX
LOW FREQ SIG INPUT
LOW FREQ SAMPLES
LOW FREQ INTEGRATED SCOPE DISPLAY
HIGH FREQ SIG INPUT
HIGH FREQ SAMPLES
HIGH FREQ INTEGRATED SCOPE DISPLAY

Fig. 3—How the random sampling technique works on both low-frequency and high-frequency waves.

til the next time the gate opens. This static charge is presented to the deflection amplifier, and a current proportional to the stored value is generated through the yoke, causing consequent deflection.

This sampling method is the secret of the low-frequency response. Even the lowest-frequency waves are sampled a large enough number of times to display them accurately on the C-R tube screen.

Yet the inductance of the yoke is still there, after the signal has passed the deflection amplifiers, to delay the rise of deflection voltage and to distort the waveform on the screen. To solve this problem, the C-R tube beam is normally gated off. The deflection amplifier drives through the yoke a current proportional to the sample stored on the storage capacitor. The delay multivibrator and unblanking pulse generator keep the tube below cutoff till the current in the yokes has had time to stabilize against the opposition of the yoke inductance. Then the tube is turned on very briefly and a point of light plotted on the face of the scope. The vertical and horizontal position of this spot are directly proportional to the charge samples on the two storage capacitors. The display for a low-frequency wave, and how a high-frequency is handled by the random-sampling approach, is shown in Fig. 3.

On a single high-frequency cycle, there may be only 1 or 2 sampling points, which certainly would not give an indication of the wave shape. But on the next high-frequency cycle there are 1 or 2 more sampling points, that are not the same as those on the first cycle. These points all add up and because of the persistence of the CRT phosphor and the human eye, you see the entire wave on the scope screen. The integrated display is, of course, presented at a much lower frequency than the signal being sampled.

The versatility of the instrument is increased by its modular construction. It is made up in three units, the indicator, a control unit and a power supply. The indicator unit contains the 14-inch tube, the main deflection amplifiers and an 8-kv high-voltage supply. The control unit contains sampling circuitry and the controls for the C-R tube functions as well as jacks for the x and y plug-ins. The third unit is a power supply that provides all power except the high voltage for the C-R tube.

The display tube of the LS 421 is electrostatically focused and provides exceptionally high resolution, brightness and linearity. Spot size of 0.5 millimeter is better than that of most 5-inch cathode-ray tubes. It is achieved by the special design of the electron gun. The potential is 8 kilovolts. The full screen display measures 18 x 24 centimeters and the calibrated area is 15 x 20 centimeters.

The horizontal calibrated sweep speeds are 0.2 second per cm to 20 nanoseconds per cm. The uncalibrated sweep is 0.5 second to 20 nanoseconds per cm when using the time-base generator type PH2. The LS 421 is more than 6% transistorized. Tubes are used in the outputs of the deflection amplifiers. END

Youngest Hearing-aid user

UPI

Barbara Ann Yashuk, 5 months, sits out a test of her new hearing aid at the St. Louis Hearing & Speech Center. She's been using it for a month and cries when it is not put on.

Installing an ALTERNATOR

Make it a part of your mobile service business

By CHARLES J. SCHAUERS

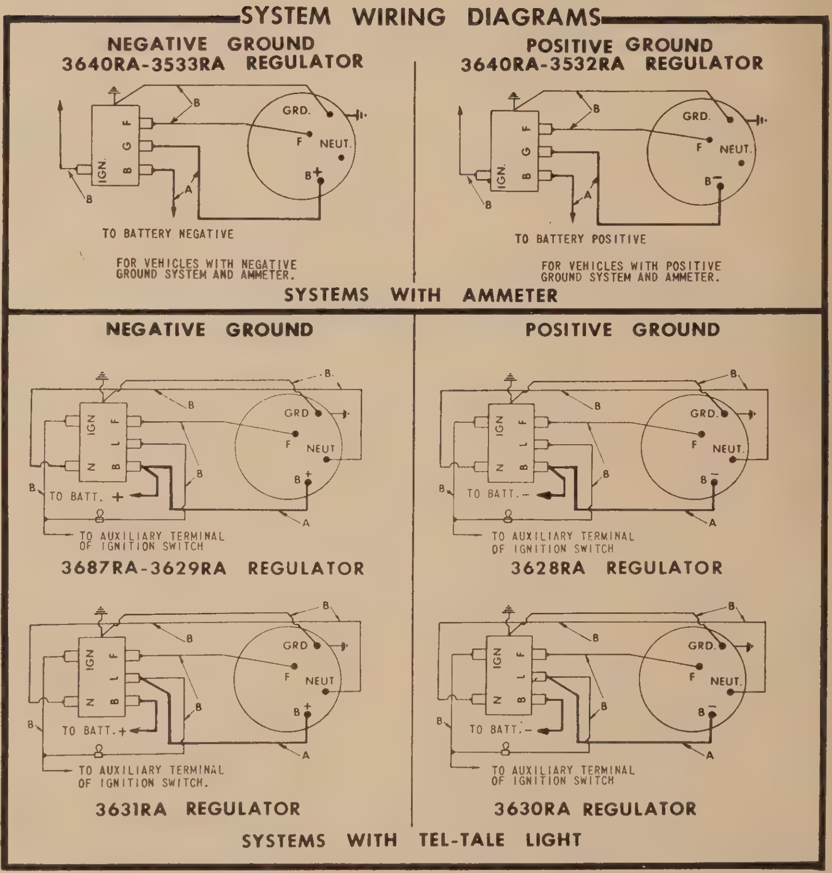
YOU'VE BEEN DOING MOBILE RADIO work all along—communications, amateur, CB—and lately more and more of customers have been asking about and buying alternators. But you've been sending the work to an automotive shop. Why? You could install the alternator system yourself. Here's how it is done.

The first step is to check the polarity of the existing automobile ignition system. Reverse battery polarity will damage rectifiers in the alternator and regulator. Once you've determined polarity (does the negative or positive end of the battery connect to the car chassis?), refer to the diagrams shown as to which alternator and which wiring arrangement to use.

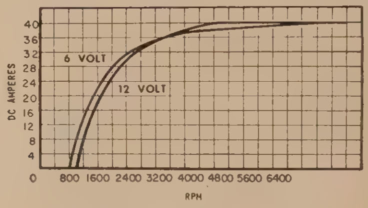
Each alternator installation kit contains all the hardware needed for a specific model car, so order the installation kit by the auto make and model. Sometimes the original fan belt is used and sometimes a new one must be provided. In almost all installations the original generator leads are used. Now let us do a typical alternator installation (step by step) in a 1960 Pontiac Catalina. We will use a Leece-Neville 6000 series alternator. A later issue will present details on maintaining and servicing alternators.

To begin, disconnect the battery—first the end connected to the car chassis. Next remove the old generator and regulator. Now follow the photos.

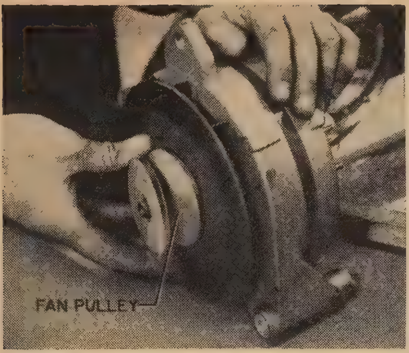
SYSTEM WIRING DIAGRAMS


NEGATIVE GROUND
3640RA-3533RA REGULATOR
POSITIVE GROUND
3640RA-3532RA REGULATOR
IGN.
B
G
F
A
GRD.
NEUT.
B+
B−
TO BATTERY NEGATIVE
FOR VEHICLES WITH NEGATIVE GROUND SYSTEM AND AMMETER.
TO BATTERY POSITIVE
FOR VEHICLES WITH POSITIVE GROUND SYSTEM AND AMMETER.
SYSTEMS WITH AMMETER
NEGATIVE GROUND
POSITIVE GROUND
N
L
TO BATT. +
TO BATT. −
TO AUXILIARY TERMINAL OF IGNITION SWITCH
3687RA-3629RA REGULATOR
3628RA REGULATOR
3631RA REGULATOR
3630RA REGULATOR
SYSTEMS WITH TEL-TALE LIGHT

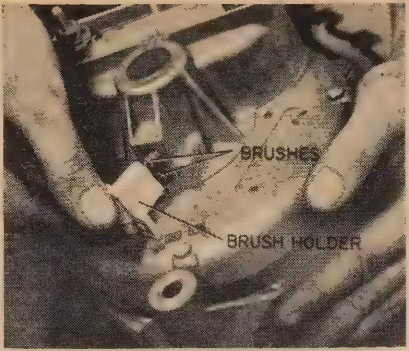
RECOMMENDED SYSTEM WIRE SIZES			
TOTAL LENGTH OF CIRCUIT IN FEET	40 AMPS		
	A	B	
15 OR LESS	#8	#16	
15 to 25	#6	#14	



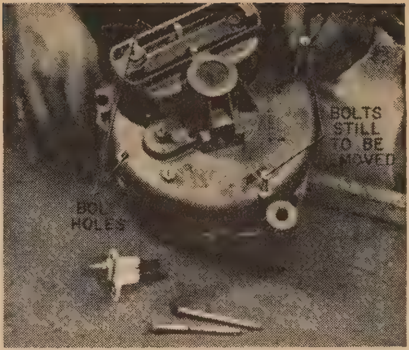
ALTERNATOR PERFORMANCE CURVE



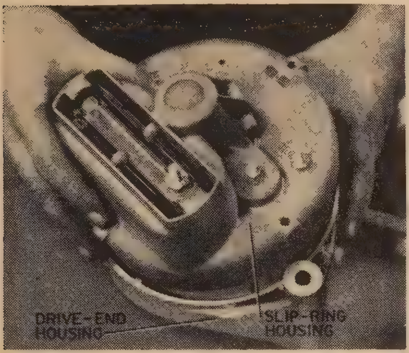
Mount fan pulley on alternator shaft.


BRUSHES
BRUSH HOLDER

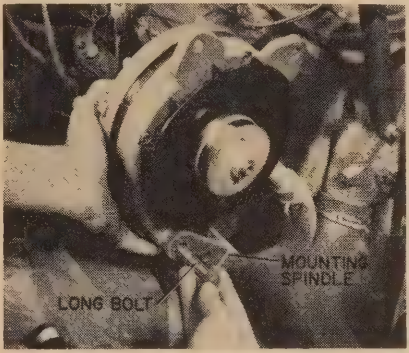
Next, remove brush holder and brushes.


BOLTS STILL TO BE MOVED
BOL HOLES

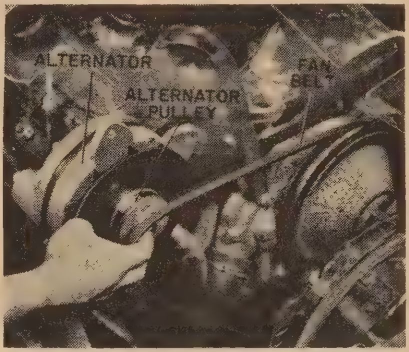
Then remove the four through-bolts.


DRIVE-END HOUSING
SLIP-RING HOUSING

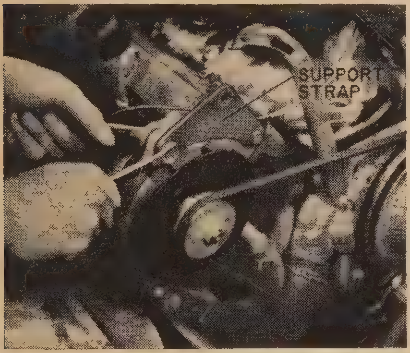
Rotate slip-ring housing, as necessary, to fit the space in the engine compartment. Replace bolts, brushes, etc.


MOUNTING SPINDLE
LONG BOLT

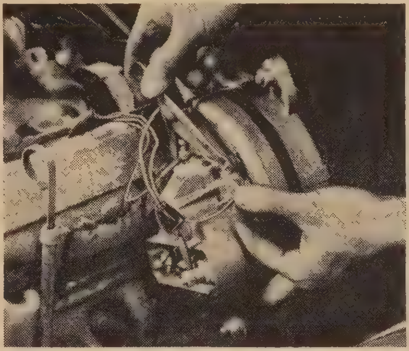
Alternator is installed in engine compartment by placing long bolt through mounting spindle.


ALTERNATOR
ALTERNATOR PULLEY
FAN BELT

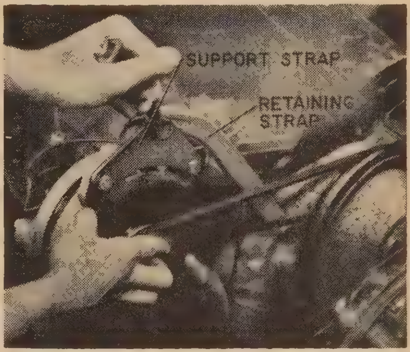
Next, the fan belt (original) is engaged in the alternator pulley grooves.


SUPPORT STRAP

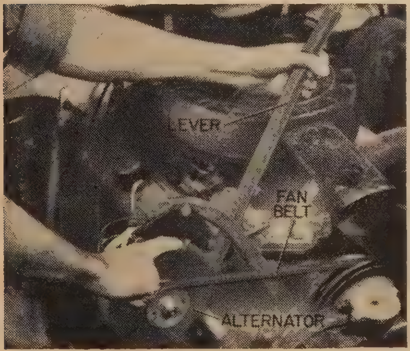
Now, mount the support strap (supplied) between the ears of the alternator.



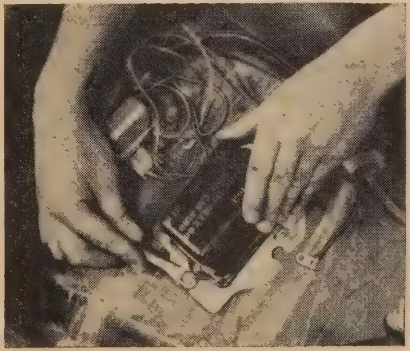
Then connect all leads to the alternator following the appropriate wiring diagram.


SUPPORT STRAP
RETAINING STRAP

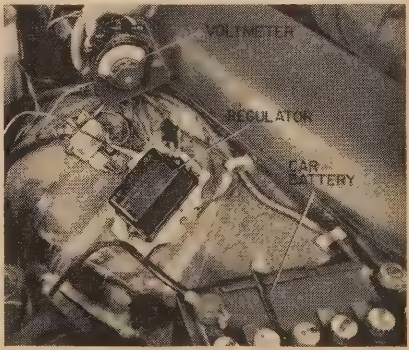
Adjust alternator position to allow for hood and fender clearances. Engage bolt to connect support strap to retaining strap.


LEVER
FAN BELT
ALTERNATOR

Using lever, move alternator until fan belt is tight enough to prevent rotating fan with fingers. Tighten retaining bolt.



Install regulator in the same location as original regulator and wire it according to proper wiring diagram.


VOLTMETER
REGULATOR
CAR BATTERY

Reconnect battery, hot lead first; grounded lead last. Run engine at least 15 minutes, check fan belt for tightness. Voltage from regulator BATT terminal should be 13.9 to 14.1 volts with 3533RA regulator, 14.2 to 14.6 with 3631RA. END

7 circuits for Tunnel Diodes

These transmitting and receiving hookups will interest the experimenter.

By CLIVE SINCLAIR

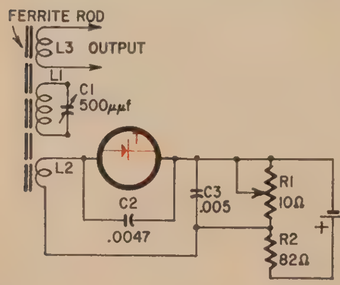
Tunnel diodes have been around a fair length of time now. We've seen several experimental circuits using them in different ways. Here, we will present circuits that show how the tunnel diode can be used as an rf amplifier and i.f. amplifier, in medium-wave and FM receivers and in an FM transceiver.

Fig. 1 shows how a tunnel diode might be used as an rf amplifier. The coils are wound on a single ferrite rod. L1 and C1 form a resonant circuit tuned to the frequency required. The tunnel diode, a 1-ma type, is biased to a negative portion of its curve by R1 and R2, which form a voltage divider across the battery.

L2, C2 and C3 form a broadly tuned circuit whose dynamic resistance must be numerically less than the negative slope resistance of the tunnel diode. Under this condition we get amplification because the negative resistance of the diode cancels some of the positive resistance of the tuned circuit, thereby raising its Q. Rf gain is thus obtained in much the same way as in a regenerative detector.

How much gain this circuit gives depends upon how close the numerical value of the tunnel-diode resistance is to the dynamic resistance of the tuned circuit—the smaller the difference, the higher the gain. If the diode's negative resistance is numerically greater than the positive resistance of the tuned circuit, the circuit will oscillate—all the resistance of the tuned circuit will have been cancelled. To get maximum gain short of oscillation, alter the diode resistance by adjusting R1. Maximum gain will be around 30 db.

Fig. 1—Tunnel-diode rf amplifier.



The same procedure works for an i.f. amplifier, with more practical results. The circuit of Fig. 1 would have to be readjusted for maximum gain each time the signal frequency was changed. In an i.f. amplifier, the frequency remains constant and retuning would not be needed.

To get gain with the circuit of Fig. 2, the diode's negative resistance must be numerically greater than the input and load impedances in parallel. Also it must be numerically less than the load impedance, which includes the shunt loss of the tuned circuit. Since it is inconvenient to vary input and output impedances to adjust the slope resistance of the diode for maximum stable gain, we have included R1 for this adjustment.

Both circuits (Figs. 1 and 2), may appear unusual, yet are conventional in the sense that they use an accepted method of amplification with a negative resistance device. Neither Fig. 1 nor Fig. 2 presents an attractive circuit because the same thing can be done better with transistors. However, at much higher frequencies, similar circuits could be used where transistors would be useless.

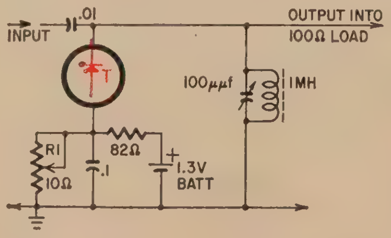


Fig. 2—Tunnel-diode 465-kc. i.f. amplifier.

Detector circuit

Unlike these circuits, Fig. 3 is both new and potentially very useful. It was developed by Standard Telephones & Cables Ltd. (S.T.C.), England, as was the circuit of Fig. 2. The circuit, then, is a detector, but one that provides full-wave rectification with only a single diode. This is done by biasing the diode to its peak current point (P in Fig. 4), so that either a negative- or positive-going signal will reduce conduction.

This might be purely academic were it not for one important advantage this detector has over a conventional one: It is sensitive to very low input voltages. An ordinary detector diode has a contact potential to overcome before efficient demodulation can occur,

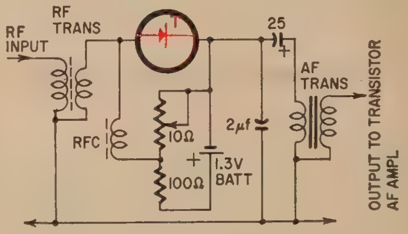
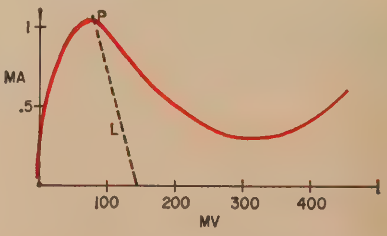


Fig. 3—Tunnel-diode detector circuit.

Fig. 4—Characteristic curve showing the point (P) to which the tunnel diode in Fig. 3 is biased. L is a load line.



the forward and reverse conductances being very much the same at very low signal levels. This means that, in a receiver, the signal has to be amplified considerably by rf or i.f. stages before being applied to the detector. Were this not so, more of the gain required in the set could be obtained by audio amplification, which is cheaper and simpler. With a detector such as in Fig. 3, such an arrangement would be possible and the cost of a set could be reduced. At ordinary AM broadcast frequencies the saving might not be very great but, in the vhf and uhf regions, rf gain becomes increasingly expensive and saving several stages becomes attractive.

As a demonstration of the potentials of this detector S.T.C. has built a medium-wave receiver in which the whole rf section consists simply of the circuit of Fig. 1 combined with that of Fig. 3. In this circuit L3 in Fig. 1 replaces the secondary of the rf transformer in Fig. 3. The audio transformer has a stepup ratio of about 3 to 1 to match the very low output impedance of the detector to that of a four-stage transistor audio amplifier. Because it needs delicate adjustment, the receiver, as it stands, is really suited only to single-station operation but it bodes well for the future of similar arrangements at very much higher frequencies.

Vhf/FM circuitry

In medium-wave receivers the transistor is so successful and well established that it is unlikely that the tunnel diode will find much application. The situation is much more promising in the FM band since transistors that can amplify and oscillate at 100 mc with a low noise level are still comparatively expensive by domestic equipment standards. They also require more complex circuits than do tunnel diodes in similar circumstances.

Tunnel diodes will probably be confined to the front end in FM receivers because transistors are more satisfactory in the i.f. sections. The same applies to receivers at all frequencies right up to the microwave region. Tunnel diodes will amplify the rf signal and reduce it to an intermediate frequency which can be comfortably handled by transistors.

The conventional transistor FM front end consists of a single-stage rf amplifier and an autodyne converter that combines the functions of mixer and oscillator. A similar arrangement with tunnel diodes needs only about half the number of auxiliary components. Compare the circuit of a typical FM front end using transistors (Fig. 5) and one with tunnel diodes (Fig. 6). The latter is not only simpler but is also likely to have a considerably lower noise level, of vital importance in this type of unit. The conversion gain may be slightly lower under some circumstances but this is of no particular importance when the noise level is very low since most of the gain of an FM tuner is in the i.f. strip.

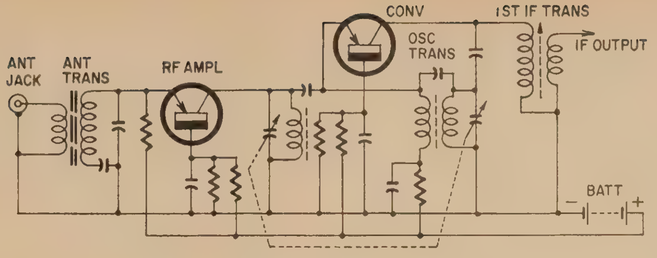


Fig. 5—Typical transistor FM front end. Compare with Fig. 6.

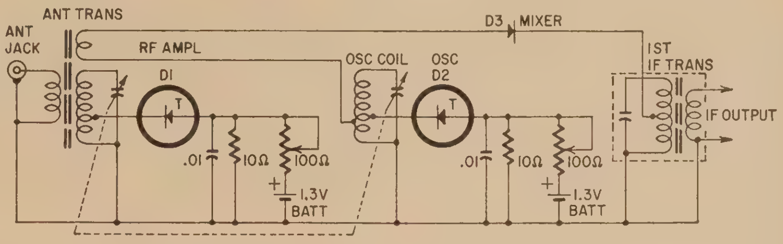


Fig. 6—FM front end using tunnel diodes. It's much simpler than circuit of Fig. 5.

In Fig. 6, D1 is the rf amplifier. The circuit is arranged so the diode is tapped into a part of the tuned circuit with a dynamic resistance just less than the numerical value of the diode slope resistance over the negative part of the curve. Gain is controlled by adjusting the voltage across the diode and is limited either by the amount of gain that can be achieved before instability occurs or by the need to maintain an adequate bandwidth in the tuned circuit.

One advantage of the tunnel-diode amplifier over transistor types is that only a single tuned circuit is necessary and no additional input transformer is required. D2 is the oscillator and operates in much the same way, except that the dynamic resistance of the tuned circuit is higher than the negative resistance of the diode. The oscillator circuit is also very simple because no feedback coil or capacitor is required. The oscillator and rf signals are mixed in D3, a conventional diode. The circuit as shown is suitable for tunnel diodes with peak currents of around 1 ma. They can be powered by a single mercury cell instead of the two shown.

A tunnel diode may be used as a mixer in place of a conventional type—Fig. 7 is one possible circuit. It is also possible to use the same tunnel diode both as oscillator and rf amplifier and even as the mixer, but adjusting such a circuit is difficult. Trouble arises because it is impossible to make all the adjustments required simply by varying the voltage across the diode, and some means has to be included to vary the Q of the tuned circuits. Since this also changes the frequency to which the circuit is tuned, precise adjustment is a long and troublesome process.

Best results with a new component are often obtained by using unconventional circuitry. This may well be true for the tunnel diode in FM tuners. Fig. 8 is the circuit of a complete FM tuner. The principle on which it works was discovered at S.T.C. in the course of experiments designed to produce a superregenerative circuit. The tuner is basically a synchrodyne receiver. Though little used and not well known, the synchrodyne has several advantages over the superhet or the trf. It is

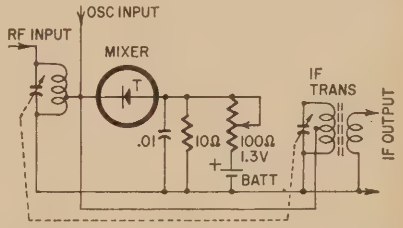


Fig. 7—Mixer circuit uses a tunnel diode.

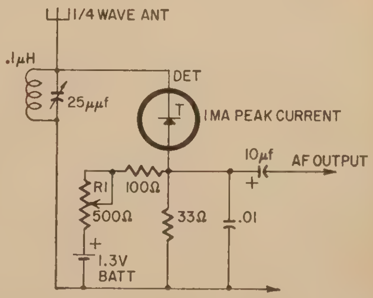


Fig. 8—Complete FM tuner needs only one tunnel diode.

most easily described as a superhet in which the intermediate frequency is zero cycles per second or dc. The local oscillator and signal frequencies are identical except that the latter is modulated. When the two are mixed, the difference output is simply the audio content of the original signal so no i.f. strip, as such, is required. The advantages of this system are low cost, simplicity and control of the bandwidth by the bandwidth of the audio amplifier.

The tuner in Fig. 8 uses a tunnel diode biased to its negative resistance region so that oscillation occurs at the resonant frequency of the tuned circuit. This circuit is tuned to the center frequency of the FM signal to be received. As the FM signal deviates from its center frequency the oscillator keeps in step with it, but the Q and hence the dynamic resistance of the tuned circuit drop rapidly as the deviation increases. The diode resistance alters in step with this so as just to cancel out the conductance of the tuned circuit and cause oscillation. As the diode resistance alters in sympathy with the modulation of the FM signal so does the voltage across it, and this forms the receiver's audio output.

The audio signal from the tuner is, of course, very small but not too small to be handled comfortably by a suitable audio amplifier. For speaker operation, feed the tuner output into a four-stage transistor amplifier. If you use a stepup transformer with a turns ratio of about 6 to 1 between the tuner and the amplifier, only three stages may be needed. If a sensitive earpiece is used one stage less will be necessary in each case.

The tunnel diode should have a 1-ma peak current (a 0.5-ma type may be used if all the resistor values are doubled) and should be a low-capacitance type such as the Philco T1925 or one of the G-E diodes. The coil may be five turns of stiff copper wire wound to a length of ½ inch on a ¼-inch diameter form.

The one disadvantage of this circuit, as it stands, is that R1 normally has to be adjusted when a new station is tuned in. This could be overcome by using several preset resistors (one for each station required), and switched tuning. It may also be possible to devise a simple control circuit that automatically adjusts the bias voltage to the correct level. The quality is excellent and from every other point of view the circuit is very satisfactory indeed. No difficulties should arise in building one of these sets.

One feature of the circuit in Fig. 8 which should not be overlooked is the ease with which it may be turned into an efficient low-power FM transmitter. Simply connect a low-impedance dynamic microphone (a miniature speaker works very well) across what are now the output terminals. To produce a deviation of ±75 kc, the microphone must provide about ±10 mv. The range of the transmitter should be about ¼ mile under good conditions, but is limited by the tiny output from the diode.

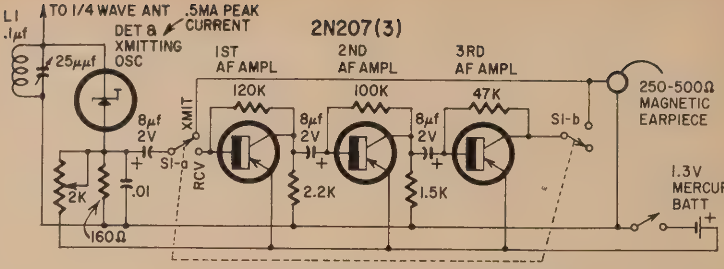


Fig. 9—FM transceiver uses tunnel diode front end and three-stage audio amplifier

Complete FM transceiver

A very simple fm/vhf transceiver may be built by using the synchrodyne principle for the receiver. The complete circuit for such a unit is shown in Fig. 9. Three subminiature transistors are used in the high-gain audio amplifier; the 2N207 was chosen because of its ability to operate well from a 1.3-volt cell. Since the total consumption of the set is less than 3 ma, a tiny Mallory RM-675 may be used as the battery and will give about 35 hours life. The earpiece also acts as the microphone and should be a very sensitive type such as those designed for use with hearing aids. S1, the TRANSMIT-RECEIVE switch, a dpdt type, is shown in the transmit position.

Coil L1 consists of five turns wound to a length of ½ inch on a ¼-inch diameter form. The diode must be a ½-ma type to make the input impedance in the transmit position as high as possible.

By using subminiature 0.1-watt resistors and tantalum capacitors throughout the unit, the transceiver could be made no larger than a matchbox and yet give remarkably good performance.

The future

One of the first applications could be a new type of remote control for TV receivers using a tunnel-diode transmitter, possibly operating in the vhf band, to avoid the need for a lengthy aerial. Such a device would be small, light and versatile—numerous controls being possible with a single unit. Tunnel diodes are likely to be used in pocket FM receivers operating in the vhf broadcast band. They may also be applied to Citizens-band transceivers.

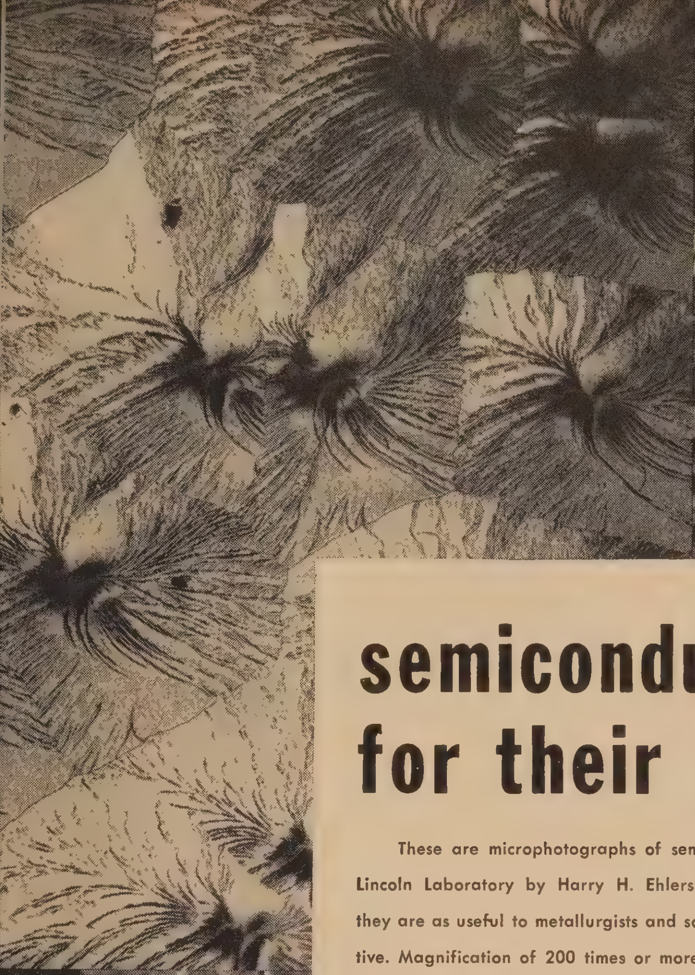
Tiny Citizens-band transceivers small enough to fit into a buttonhole could be developed. While these would have only a limited range because of their small output power, they might be very useful for interoffice, factory and home communications.

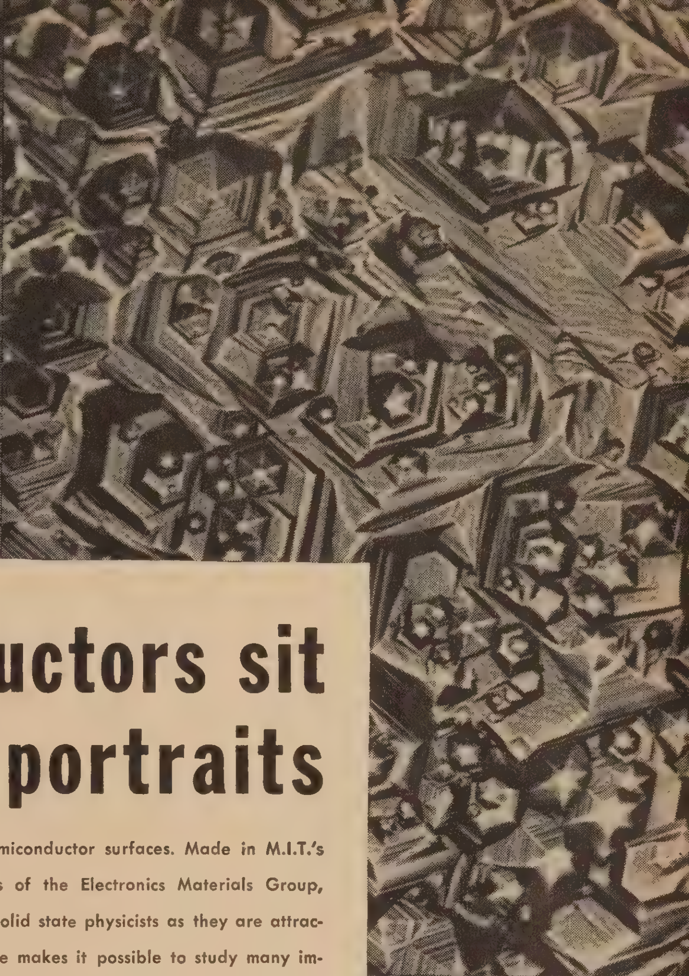
Tunnel diodes are likely to appear in TV receivers too, particularly in the front end. Their ability to act as very low level detectors might well prove useful since it could reduce the number of i.f. stages considerably. This may lead to a small revolution in TV receiver design and could accelerate the development of small portable and pocket-size TV receivers. END

IT COSTS US PLENTY

. but it protects you!

We're talking about our policy, long in existence, of insisting that all mail-order radio tube advertising in RADIO-ELECTRONICS be clearly identified as to newness, use, or otherwise perfect or imperfect condition—your assurance that you get what you pay for. This has cost us thousands in advertising, but we think it's well worth it in your good will.

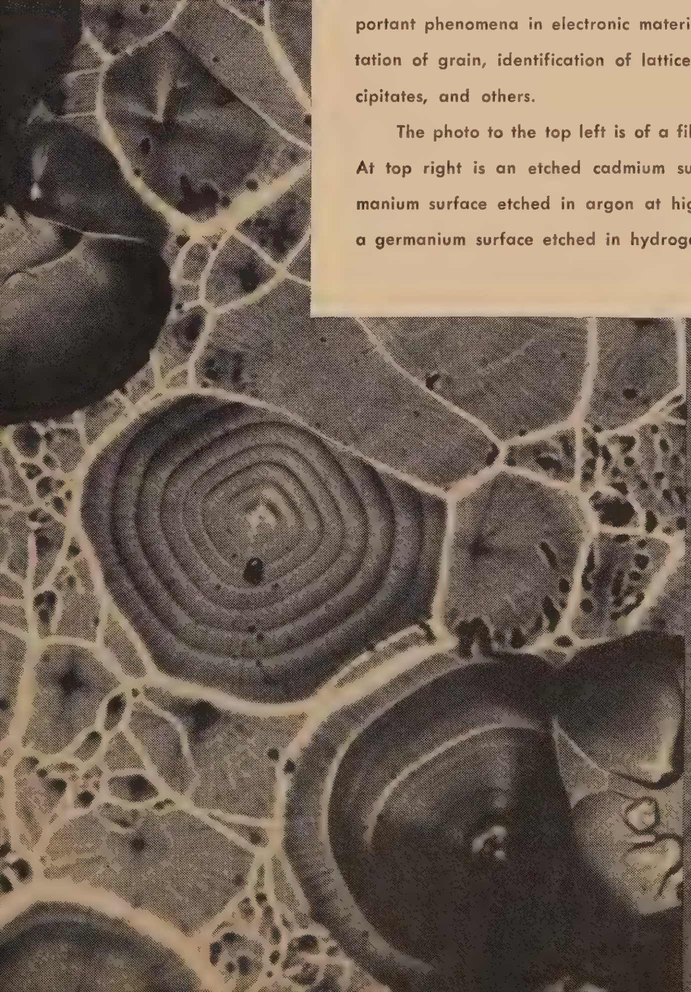


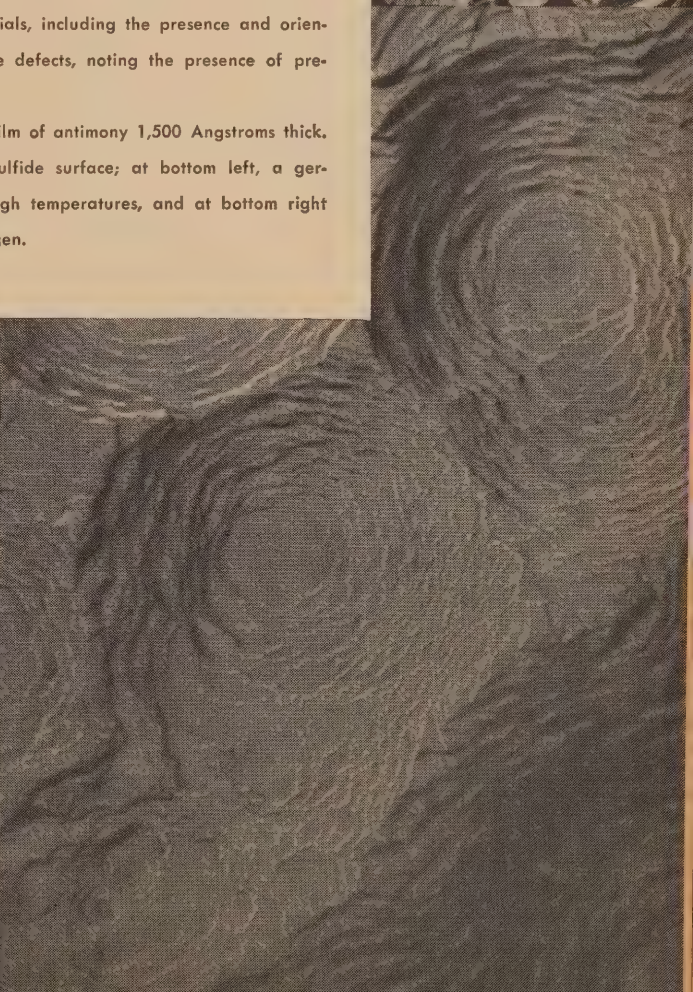


semiconductors sit for their portraits

These are microphotographs of semiconductor surfaces. Made in M.I.T.'s Lincoln Laboratory by Harry H. Ehlers of the Electronics Materials Group, they are as useful to metallurgists and solid state physicists as they are attractive. Magnification of 200 times or more makes it possible to study many important phenomena in electronic materials, including the presence and orientation of grain, identification of lattice defects, noting the presence of precipitates, and others.

The photo to the top left is of a film of antimony 1,500 Angstroms thick. At top right is an etched cadmium sulfide surface; at bottom left, a germanium surface etched in argon at high temperatures, and at bottom right a germanium surface etched in hydrogen.





NEW
Test Instrument for FM Stereo

Fisher model 300 Multiplex Generator transmits signals for testing and aligning multiplex tuners and adapters

By **WAYNE LEMONS**

THE FISHER
MULTIPLEX GENERATOR • MODEL 300

BASICALLY THIS NEW TEST INSTRUMENT is a miniature, high-stability, multiplex FM transmitter that can be used to broadcast stereo signals for testing and aligning FM stereo tuners and multiplex (MPX) adapters.

Since FM stereo broadcasting is fairly new, a short explanation of the FCC rules and standards should help us better understand why there is a vital need for an instrument such as the 300.

In the FCC approved system, left (L) and right (R) signals are combined (L + R) and used to modulate the main channel, a band of frequencies from 50 cycles to 15 kc. (This is the only part of the stereo signal reproduced by a monophonic tuner.)

The stereophonic subchannel is modulated with the difference information of L and R, designated L — R. The subchannel carrier frequency is 38 kc but, for practical reasons, the carrier is suppressed and only the sidebands are utilized.

To control and time the subchannel for reproduction at the receiver, a 19-kc pilot carrier (half of 38 kc) is added. These three signals make up the *MPX* signal which in turn is *frequency-*modulated on the FM station carrier. Another signal for "store-casting," SCA (Subsidiary Communications Authorization), is often added. It occupies the band of frequencies from 60 to 74 kc and is frequency-modulated on a 67-kc subcarrier. The distribution of these signals is shown in Fig. 1.

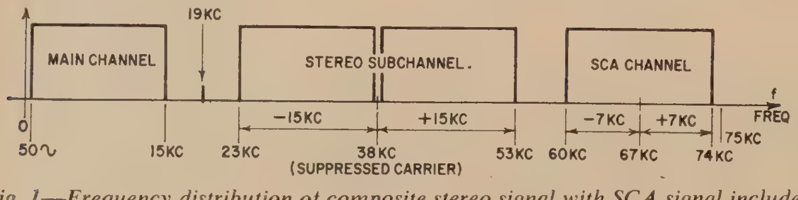


Fig. 1—Frequency distribution of composite stereo signal with SCA signal included.

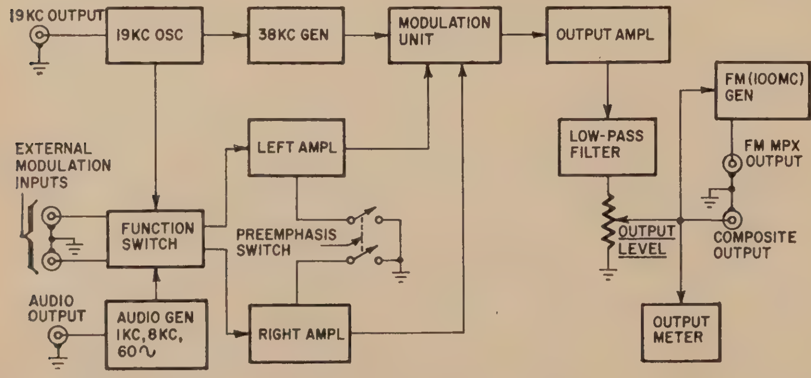


Fig. 2—Block diagram of Fisher 300 multiplex generator.

With these facts in mind, let's see how the Fisher model 300 derives these composite signals.

The fundamental timing device (Fig. 2) of the generator is a crystal-controlled 19-kc oscillator factory-set to be correct within 0.5 cycle. (The FCC allows a 2-cycle deviation.) A doubler stage produces a 38-kc carrier. This is fed to the modulation section through a Cowan type switch described later. An audio generator produces fixed signals of 1 kc and 8 kc for modulating either of the internal R and L amplifiers. (A 60-cycle signal, derived from the power line, is also available.) The function switch can also select external modulation so that a stereo source, such as a record or tape player or another tuner, may be used to modulate the 100-mc FM carrier produced by the multiplex generator.

The 1-kc and 8-kc signals are available on the rear panel of the instrument, both for phase adjustment with a scope and for signal tracing or other purposes.

An output meter connected to the COMPOSITE OUTPUT jack indicates either output voltage, modulation percentage or amplitude of the pilot carrier.

The modulation section

Though most of the circuitry of the model 300 is fairly conventional, the modulation circuit is an exception. The modulator cannot exactly be called a suppressed-carrier system, but for all practical purposes the effects are the same. It is actually a switching circuit with a switch rate of 38 kc (Fig. 3). With the switch up, output from the

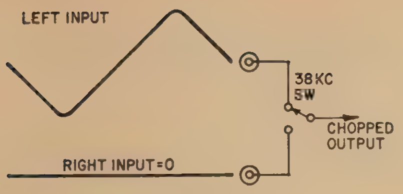


Fig. 3— 38-kc switch.

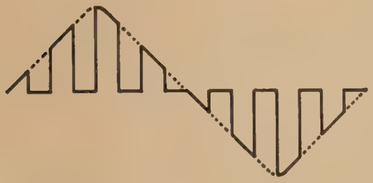


Fig. 4—This signal comes out of the switch of Fig. 3.

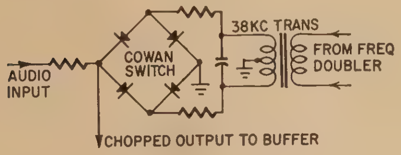


Fig. 5—Cowan type diode switch.

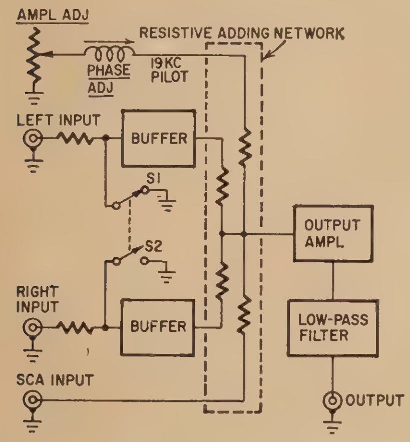


Fig. 6—Block diagram of the multiplex generator's modulation section.

LEFT INPUT is fed to the modulator. On the next half-cycle, the switch moves down and the output is taken from the RIGHT INPUT. With the left input as shown and no input to the right channel, the resultant output signal resembles Fig. 4.

This system of modulation is much easier to build and adjust than the more complicated suppressed-carrier modulator with its complex filter networks. Though the "switch" system is less complicated, it does have more harmonics but these have been proven to be only odd order ones (third, fifth, seventh, etc.) easily removable with one fairly simple low-pass filter.

The Cowan type 38-kc diode switch (Fig. 5) uses silicon diodes for good stability and high front-to-back ratio. Two of these diode switches are used. They are connected across the 38-kc source to short one input effectively to ground while allowing the other input to pass a signal during one half-cycle. The process is reversed on the next half-cycle. See Fig. 6 for a block diagram of the MPX modulation unit. One of the diode switches is represented by S1 and the other by S2. Figs. 7-a and 7-b show a sine-wave audio input signal and the signal output from the switch. The serrations are the result of the 38-kc switching frequency.

This switch type modulation clearly shows how the two 100% modulated signals will not overmodulate the transmitter, a fact not so easily seen using a suppressed-carrier analogy. As you can see in Fig. 6, only *one* signal, either right or left but not both, modulates the transmitter at a time. While one signal is being used, the other is shorted to ground.

Figs. 8-a, 8-b, 8-c show actual modulated output with different modes of operation. Fig. 8-d is the same as 8-c but with the 19-kc pilot carrier added.

Using the model 300

The model 300 will be used for aligning and testing two kinds of FM stereo equipment: integrated FM–MPX tuners and for separate MPX adapters. Note that the i.f. and detector circuits of an FM tuner usually have considerable influence on the performance of an MPX adapter, so it is highly desirable that you align an MPX adapter with the tuner it is to be used with. Follow the specific manufacturer's instructions, which usually include adjusting SCA traps or filters, if used; adjusting the 19- and 38-kc circuits, and adjusting for best stereo separation. Here's how to do this with the model 300:

1. Allow the tuner and the model 300 to warm up for 15 minutes or more.

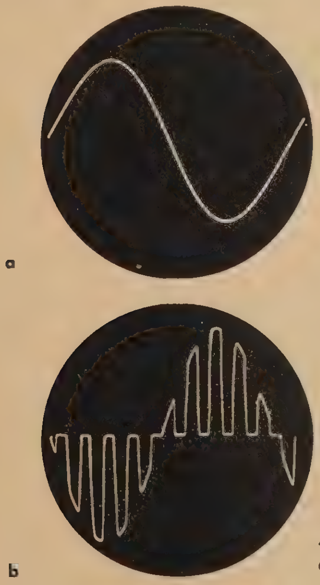


Fig. 7—Sine-wave input (a) and the output from the switch (b).

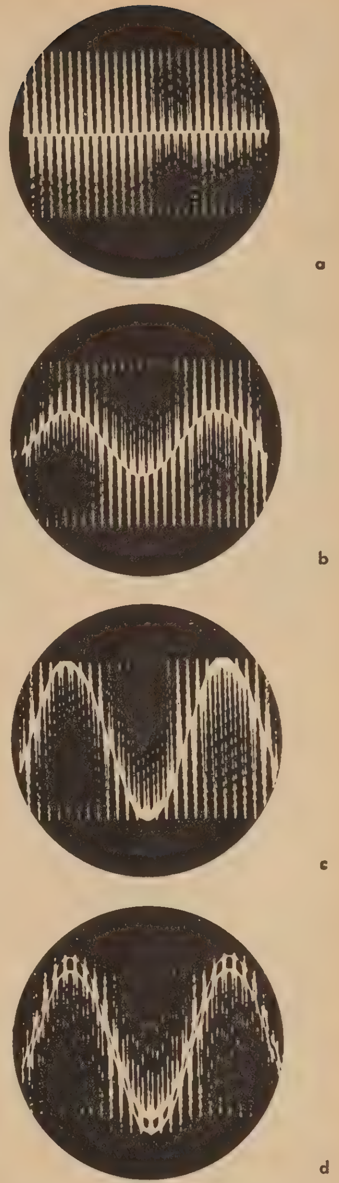


Fig. 8—Actual modulated signals produced by the generator: (a)—1-kc right signal without pilot carrier; (b)—1-kc right signal plus 60-cycle left signal; (c)—1-kc right signal plus 60-cycle left signal—equal amplitude; (d) same signal as in c but with 19-kc pilot added.

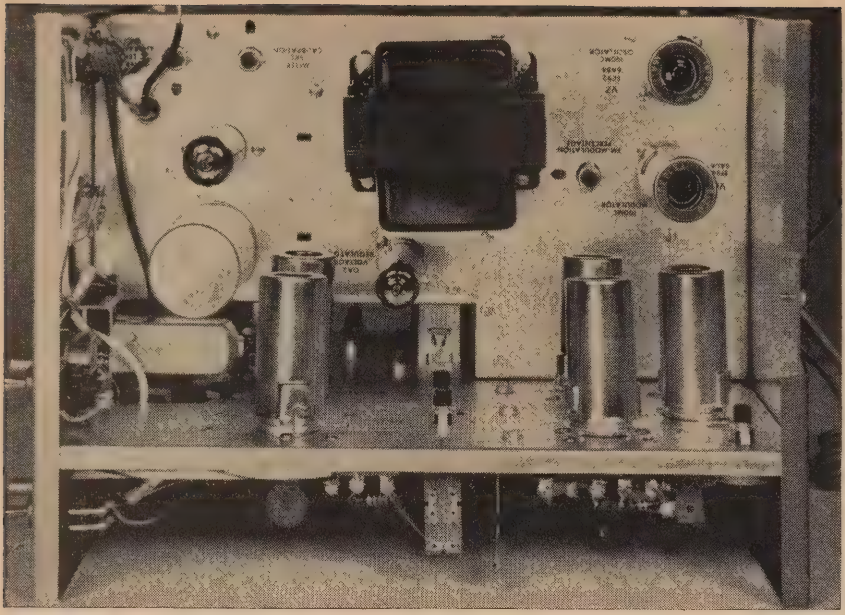
2. Read the manufacturer's instructions and adjust any SCA traps or filters accordingly.

3. Set the controls as follows: POWER—ON, PRE-EMPHASIS—OFF, LEFT SIGNAL 7, RIGHT SIGNAL 7, and the SELECTOR to 1 KC LEFT.

4. Turn the COMPOSITE SIGNAL level control for a reading of 1 on the meter's top scale. This corresponds to 75-kc deviation.

5. Depress the 19-KC AMPLITUDE pushbutton and adjust the 19-KC AMPLITUDE ADJ for a reading of 100 mv on the meter scale.

6. Connect the rf output cable



With the cover removed the chassis is revealed.

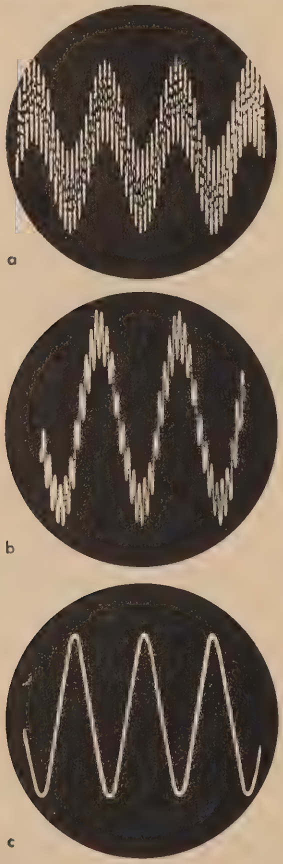


Fig. 9—Channel separation can be set with generator and scope: Monophonic signal (a), poor separation (b), good separation (c).

from the 300 to the antenna terminals of the FM receiver. (Usually it won't be necessary to make a direct connection to the antenna terminals. If not convenient, just bring the output cable close.)

7. Follow the manufacturer's adjustment procedure.

To align MPX adapters

1. Adjust any SCA traps or filters according to manufacturer's instructions.

2. Adjust the 300's controls as follows: POWER—ON, PRE-EMPHASIS—OFF, LEFT SIGNAL 7, RIGHT SIGNAL 7, SELECTOR 1 KC LEFT.

3. Turn the COMPOSITE SIGNAL level control to the desired level and the 19-KC AMPLITUDE ADJ for the same reading.

4. Complete the alignment according to the manufacturer's instructions.

As you get better acquainted with the model 300 and with FM stereo equipment, it will take you less and less time to check or correct alignment or to troubleshoot.

As an example, you can often align rapidly by setting the SELECTOR to 1 KC LEFT and 60 CYCLES RIGHT.

Channel separation can be set visually with a scope. Fig. 9-a shows monophonic operation. Fig. 9-b shows stereo operation with poor separation and Fig. 9-c shows stereo operation with good separation. These waveforms are taken from the R channel of an FM-MPX tuner.

Make listening tests by simply connecting a stereo source (a record or tape player, for example) to the R and L modulation inputs on the model 300 and connecting the rf output cable to the receiver you are testing.

An instrument such as this would be invaluable for technicians who want to adjust multiplex stereo systems properly. Because the model 300 is laboratory quality, it would certainly be an excellent design tool for the engineer.

We found the 300 easy to operate with no complicated setup procedures and with an instruction book that is comprehensive and easy to follow. END

Simplified 'Instant-On' Circuit

TO THOSE WHO MAY BE TOYING WITH THE idea of applying this new circuit (RADIO-ELECTRONICS, January 1962, page 29) to their favorite ac–dc radio, the following simplified circuit should be of interest. A dpst switch is not required, and wiring changes can be made in a matter of minutes, without removing or replacing any parts. The only added component is a 500-ma 400-piv silicon diode connected across the existing on–off switch. In the usual "Instant-On" circuit, a second section of the on–off switch is required.

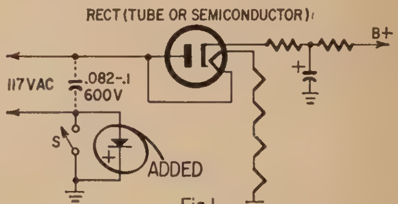


Fig.1

The circuit in Fig. 1 illustrates the one most commonly used where the on–off switch is located in the B-minus return side of the power line. Minor variations of this circuit will, of course, be encountered. Silicon rectifier polarity must be as shown. Fig. 2 illustrates the situation where the on–off switch is in the other side of the line. —*J. P. Jeffries*

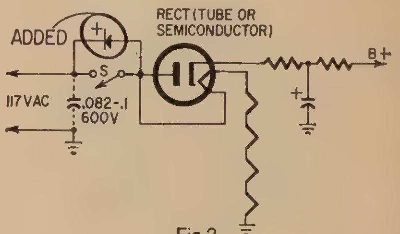


Fig.2

[This circuit is used in Canadian Westinghouse sets. The Editor tried it before publishing the January article. He had trouble with repeated breakdowns of the added silicon rectifiers. Research showed that this was due to an unusual transient condition on the power line in his home. Bridging the line at the receiver with a .082-μf capacitor cured the trouble.]

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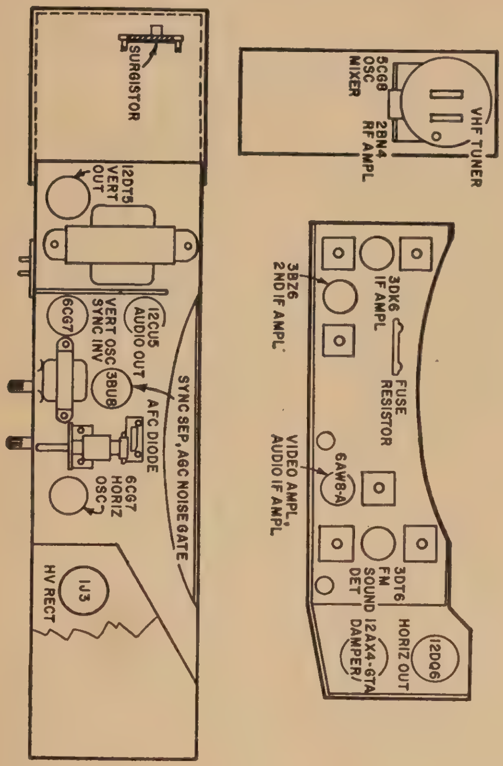
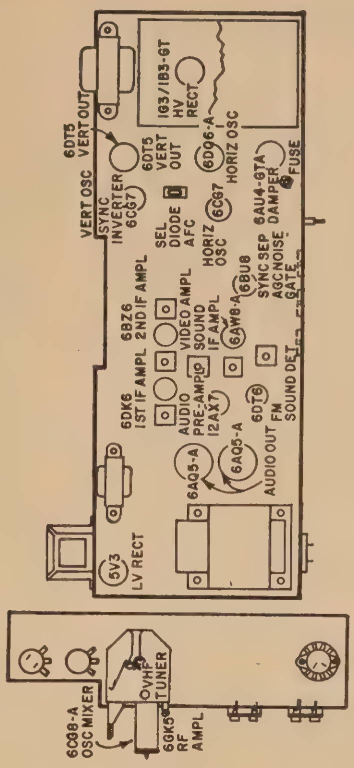

SURGISTOR
VHF TUNER
5CG8 OSC MIXER
2BN4 RF AMPL
12DT5 VERT OUT
12CU5 AUDIO OUT
6CG7 VERT OSC SYNC INV
3BU8
AFC DIODE
SYNC SEP, AGC NOISE GATE
6CG7 HORIZ OSC
1J3 HV RECT
3BZ6 2ND IF AMPL
3DK6 IF AMPL
FUSE RESISTOR
6AW8-A
VIDEO AMPL, AUDIO IF AMPL
3DT6 FM SOUND DET
12AX4-GTA DAMPER
12DQ6 HORIZ OUT

CHASSIS 1150-80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6DT5 VERT OUT
VERT OSC SYNC INVERTER 6CG7
6DT5 VERT OUT
SEL DIODE AFC
6DQ6-A HORIZ OSC
HORIZ OSC 6CG7
6AU4-GTA DAMPER
FUSE
SYNC SEP AGC NOISE GATE 6BU8
6BZ6 2ND IF AMPL
6DK6 1ST IF AMPL
VIDEO AMPL SOUND IF AMPL 6AW8-A
AUDIO PRE-AMPL 12AX7
6AQ5-A
6AQ5-A
6DT6 FM SOUND DET
AUDIO OUT
5V3 LV RECT
VHF TUNER
6CG8-A OSC MIXER
6GK5 RF AMPL

CHASSIS 1062-91

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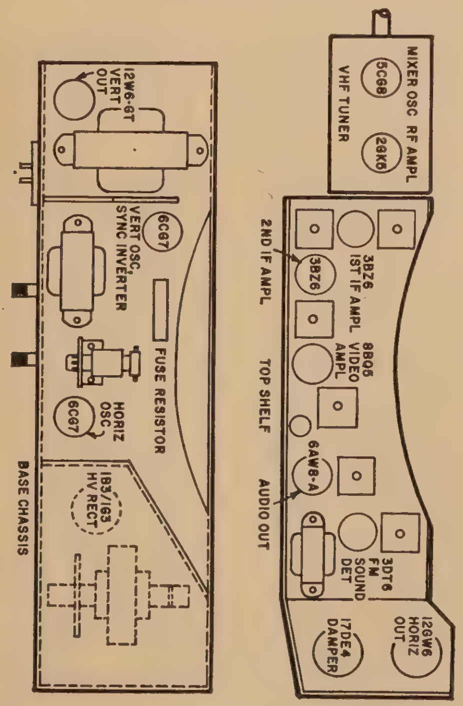
TRIM HERE AFTER FOLDING

CHASSIS 1188-12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2GK5
VHF TUNER
12W6-GT VERT OUT
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VERT OSC, SYNC INVERTER
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HORIZ OSC
1B3/1G3 HV RECT
BASE CHASSIS
3BZ6 1ST IF AMPL
3BZ6
2ND IF AMPL
8BQ5 VIDEO AMPL
TOP SHELF
6AW8-A
AUDIO OUT
3DT6 FM SOUND DET
12GW6 HORIZ OUT
17DE4 DAMPER

Radio-Electronics

TUBE LAYOUTS
IN TV SETS

Compiled by Larry Steckler, Associate Editor

TRAVLER

1960—1962

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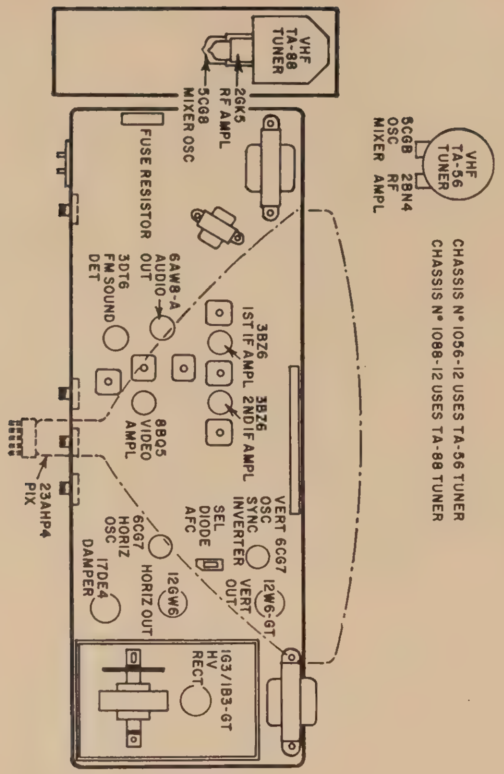
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CHASSIS Nº 1088-12 USES TA-88 TUNER
FUSE RESISTOR
6AW8-A AUDIO OUT
3DT6 FM SOUND DET
3BZ6 1ST IF AMPL
3BZ6 2ND IF AMPL
8BQ5 VIDEO AMPL
23AHP4 PIX
VERT 6CG7 OSC SYNC INVERTER
SEL DIODE AFC
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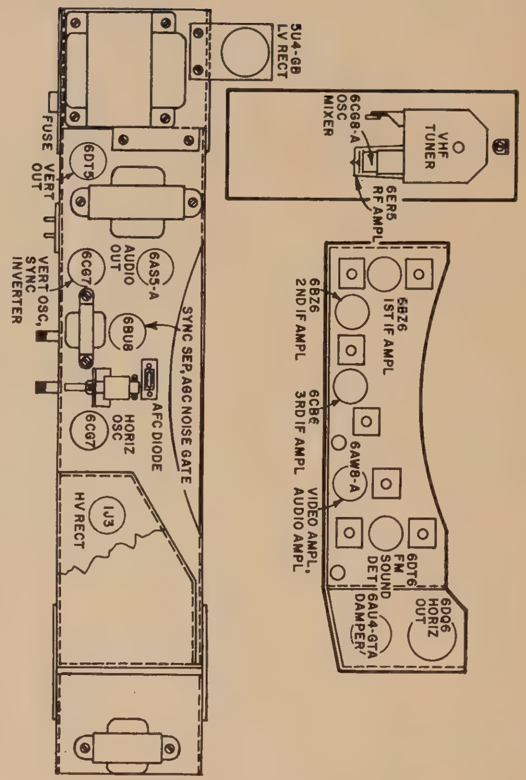
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SYNC SEP, AGC NOISE GATE
6BU8
AFC DIODE
6CG7 HORIZ OSC
1J3 HV RECT
6BZ6 1ST IF AMPL
6BZ6 2ND IF AMPL
6CB6 3RD IF AMPL
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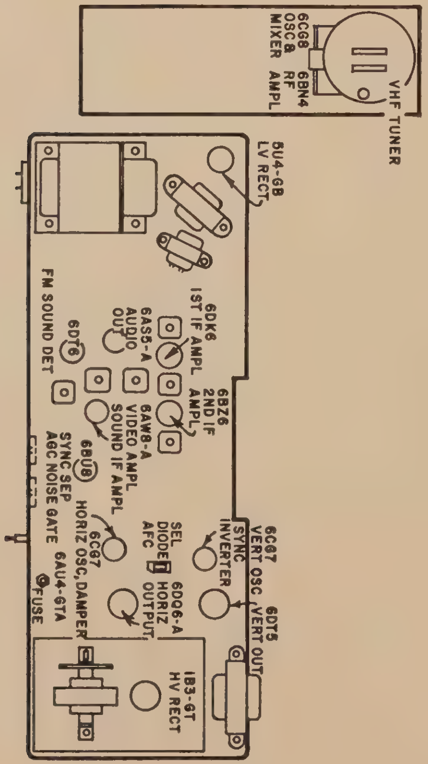
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6DT6
FM SOUND DET
6BU8 SYNC SEP AGC NOISE GATE
6CG7 HORIZ OSC, DAMPER
6AU4-GTA
FUSE
SEL DIODE AFC
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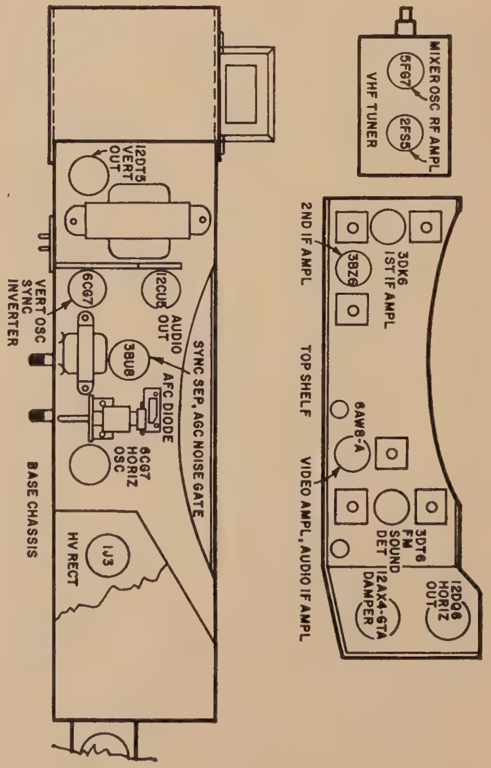
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3DT6 FM SOUND DET
12DQ6 HORIZ OUT
12AX4-GTA DAMPER
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BASE CHASSIS
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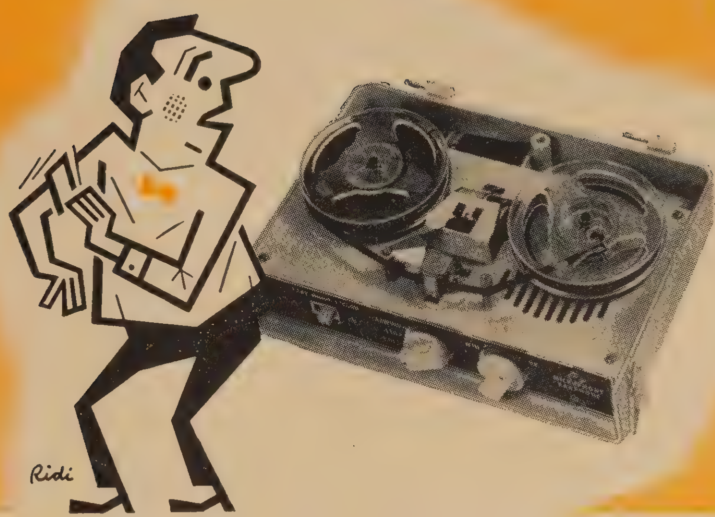


Servicing the economy Tape Recorder

What to do when that $25 recorder comes into the shop

By JERRY L. OGDIN

THESE INEXPENSIVE MACHINES (RETAIL price from $25 to $50) usually accept 3-inch tape reels and have no capstan. "Reel-to-reel" drive is used. A motor shaft drives the rubber rim of a turntable on which the reels are placed.

When the tape is moving forward, the motor shaft presses on the rim of the takeup turntable and rotates it. The take-up reel pulls the tape off the supply reel and across the heads. The supply turntable spins freely. The diameter of the tape on the reel increases gradually. Because the take-up reel is rotating at a constant number of revolutions per minute, tape speed across the head increases as the tape is played.

The tape speed on a typical machine may vary from 3¼ ips at the beginning of a tape (Fig. 1-a) to 6½ ips at the end (Fig. 1-b).

The basic system is similar to conventional tape recorders. The same thing occurs in both, but the tape speed of the conventional recorder is controlled by the capstan assembly. In recorders with a capstan, the drive to the takeup turntable only winds the tape on the takeup reel.

Mechanical operation

Another unique feature, used to reduce cost, is found in most of these sets. The motor is mounted on a bracket supported at each end, so that it can rock from side to side, as shown in Fig. 2. It is much like a cradle. There are two shafts on the motor, one at each end. By lifting up one side of the cradle, one shaft of the motor presses against the rubber rim of its associated turntable. This lifting is done by the motor switch, which moves against one of the control tabs. At the same time, the switch closes, starting the motor. The same switch controls the head pad. The pad is pulled off the head surface in the REWIND and STOP positions.

The motor's rewind shaft is larger in diameter than the forward shaft. This makes rewind faster than forward. The larger shaft can be seen in Fig. 2. There is no fast forward on these machines.

Electronics

Fig. 3 shows the circuit of a typical economy recorder. The amplifier is conventional. The record–play switching merely turns the amplifier "end for end," so that it amplifies the head out-

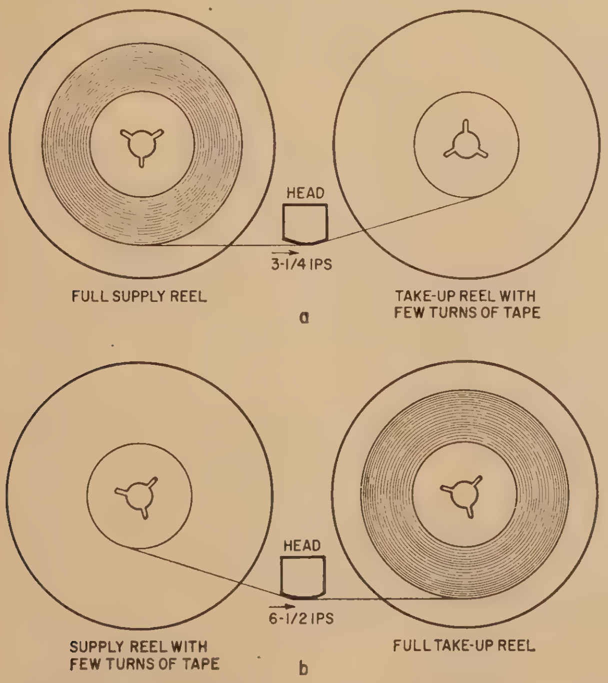
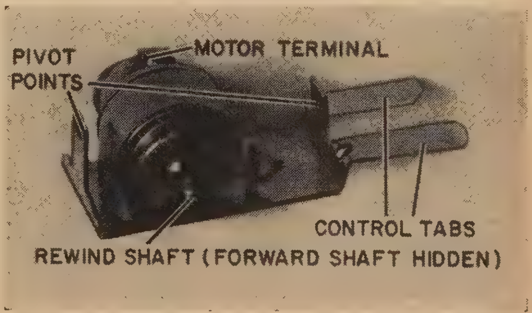

HEAD
3-1/4 IPS
FULL SUPPLY REEL
TAKE-UP REEL WITH FEW TURNS OF TAPE
a
HEAD
6-1/2 IPS
SUPPLY REEL WITH FEW TURNS OF TAPE
FULL TAKE-UP REEL
b

Fig. 1—When take-up reel is empty (a), tape speed is 3¼ ips. When supply reel is empty (b), tape speed is about 6½ ips.

Fig. 2—The motor and cradle assembly. The rocking action is controlled by the control tabs.



put in PLAY, and the microphone input in RECORD. When recording, the speaker is disconnected but, on most machines, an earphone may be used to monitor recording. Meters or other level indicators are not used, so earphone monitoring is recommended.

C1 is used for equalization while C2, which some manufacturers omit, bypasses the motor.

One make of recorder does not have an output amplifier and speaker in the unit, but uses an external cabinet for them.

The network composed of C3, R1 and R2 from V4's collector to the record-play switch is an *ac* voltage divider to provide proper record level. It is returned to the B-minus line to provide *dc* recording bias.

There is no bias oscillator in these machines. Erasing is done by a permanent magnet on which the tape runs when recording. The erase magnet covers the top half of the tape, because the head is half-track. In the machine shown, an Apolec RA-11, the erase magnet is attached to a white and red "flag." When S1 is thrown to RECORD, the red portion of the flag shows through a window in the head cover.

When the slide switch is in RECORD, the motor system cannot rewind the tape, so accidental erasure is avoided.

Shooting trouble

Servicing is conventional, keeping in mind the strange nature of the recorders. There are three types of troubles: mechanical, audio and operational.

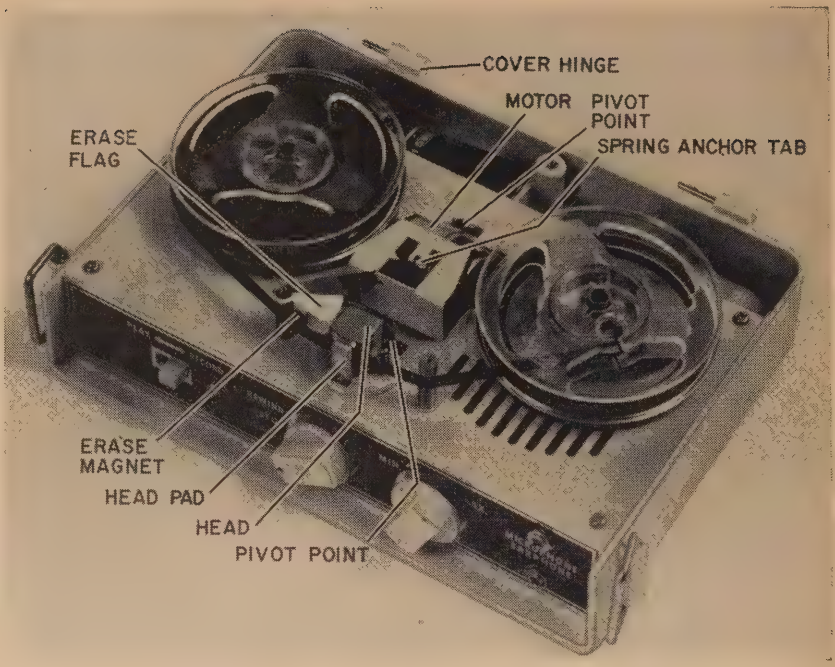
The most obvious is the latter and, before the set is opened for servicing, should be checked. Customers often misinsert the batteries, place the tape on the wrong side of the head pad, twist the tape or misthread it.

The head should be cleaned, as most customers and users of this type of recorder are not as meticulous as an audiophile.

Mechanically, improper pressure may occur as the motor cradle spring ages. Correct pressure can be checked without tools. With the function switch (rotary in the example) in REWIND position, apply enough finger pressure to the rotating turntable to stop it. Because of friction, the motor shaft should also stop. If it continues to rotate, the pressure is too light. If, however, after removing finger pressure, the turntable does not start immediately, the pressure is too great.

The tab which holds the fixed end of the motor cradle spring can be bent *away* from the cradle for more pressure or *toward* it for less pressure.

Should the motor be suspect, measure its *dc* resistance. It should be around 5 to 10 ohms.



Top-chassis view of an inexpensive tape recorder.

If all runs well but the machine doesn't record or play, apply an audio signal across the head terminals and turn the switches to PLAY. If signal is heard from the speaker, disconnect the head and read its *dc* resistance.

Testing the *dc* resistance of magnetic heads is discouraged by all literature on tape recorders. However, the test is applicable here. Ohmmeter testing magnetizes the head, and increases the noise level of a tape machine. The noise level in economy tape recorders is high to begin with, and no increase in noise is noticed after *dc* testing. The *dc* resistance of the head is normally between 100 and 1,000 ohms.

If the amplifier is defective, inject an audio signal at the base of each transistor to isolate the bad stage. If no signal generator is handy, *you* will do. Touch one finger to a collector of the output stage and another finger to each base, starting with the first transistor. You will form a feedback loop, causing the amplifier to oscillate around the good stages. (You can do this with nearly all transistor audio amplifiers.)

The usual grade of components in these sets includes a rather offbeat type of resistor. The ends of the resistor bodies, although painted gray, often short to the nearest object. Before testing the amplifier, see that each component "stands alone." Sometimes, transistor leads may contact each other.

Some amplifiers use heat sinks on the output transistor. These are formed metal vanes which fit over the transistor body. The heat sink should not be removed. It dissipates heat from the last transistor. This lessens the possibility of damage by thermal runaway.

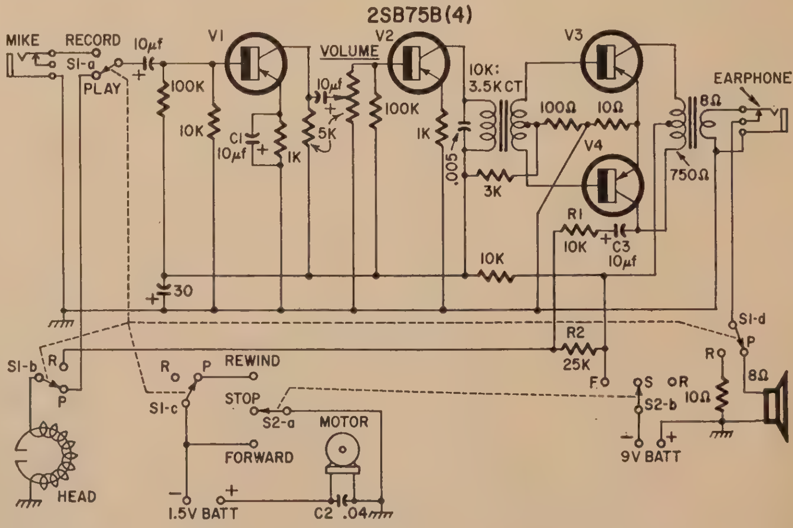
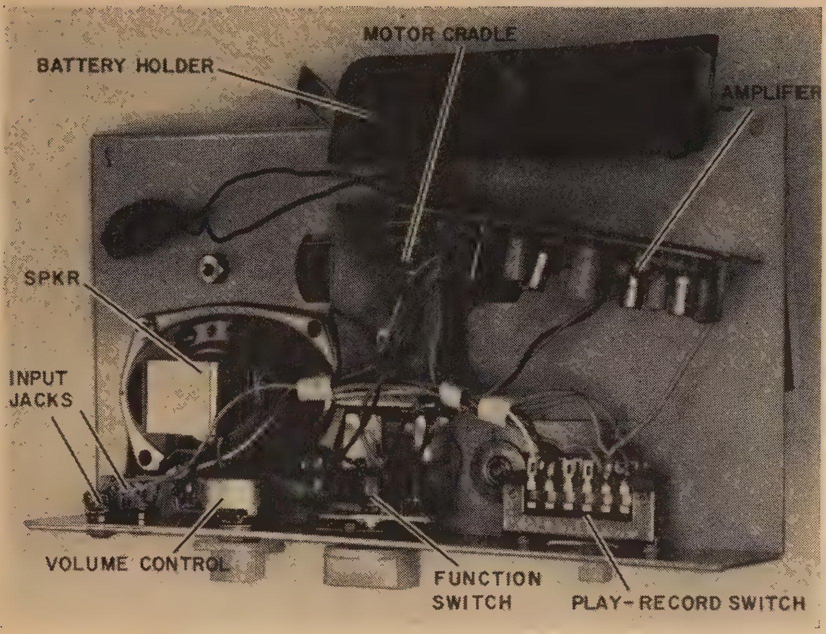


Fig. 3—Circuit of typical economy tape recorder. In some models S2-b terminals FR are connected.



Location of main components inside the recorder.

If everything through the amplifier works, check the speaker line. Sometimes the contacts on the earphone jack open. Rebend them to repair this trouble.

If the machine plays but does not record, check the microphone. Apply an audio signal to it and listen for "talk-back." Crystal microphones are used in these recorders. If the microphone is good, its jack and the recording network from V4's collector should be tested.

To test the recording system, inject an audio signal across the head, with the machine in the RECORD mode. If this can be heard on PLAYBACK, inject a signal at the collector of the output stage and the base of each stage, working toward the first transistor. Listen to the playback after each test.

Voltage readings throughout the circuit may point to defects. Circuit voltages depend on transistors and circuitry. A voltmeter with a sensitivity of at least 20,000 ohms per volt should be used. END

Narrow-Band Two-Way Radio Rules

DOES ALL EQUIPMENT IN YOUR MOBILE radio system meet FCC narrow-band technical standards? If you originally installed a wide-band system, have you converted or replaced the old equipment with new, meeting present more stringent narrow-band standards? If you haven't, now is a good time to plan to do so; the final deadline is drawing near.

New narrow-band standards come into full effect on Nov. 1, 1963. By that time all transmitters must comply with the FCC rules. Receivers should comply if you are to get the best performance in range, freedom from noise, minimum squelch burst and freedom from adjacent-channel interference. This is more than ever likely to occur with split-channel assignments treated with the same degree of frequency coordination as the primary channels.

Assuming your transmitters are all now adjusted for ±5-kc swing (an interim requirement), there are two other requirements you must meet by Nov. 1, 1963. First, transmitters operating in the 25-50-mc band must now have a frequency stability of .002% and in the 150-174-mc band .0005%.

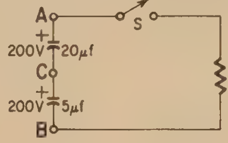
Second, each transmitter must include a low-pass audio filter placed between the instantaneous modulation limiter and the modulator stage of the transmitter. Equipment originally supplied as complying with the narrow-band standards of course contains all three features as supplied by the factory—±5-kc swing, .002% or .0005% frequency stability as required, and low-pass audio filter.—*John A. McCormick, G-E Mobile Radio*

What's Your EQ?

Answers on page 68

A Capacitance Problem

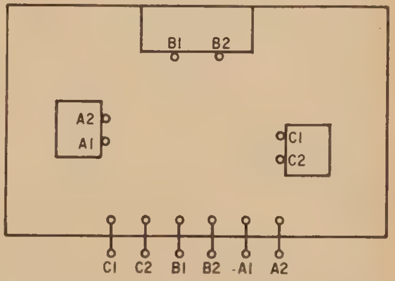
Two capacitors, a 20-μf and a 5-μf unit, are each charged to 200 volts, then connected in series so their voltages add up to 400 (see diagram). Switch S is then closed, putting a 500,000-ohm load across the series combination.



What will be the end condition of this circuit, and how long will it take to reach it? (For the purposes of this problem, an R-C circuit can be considered to reach its final condition in five time constants.)—*Walther Richter*

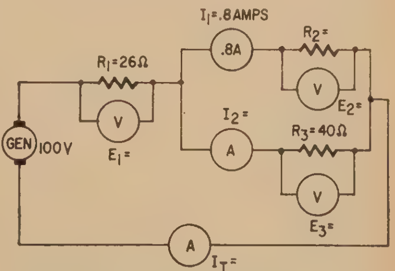
A Tracking Problem?

An early worker with printed-circuit boards was given the board shown in the diagram with three components to be mounted as shown, and a set of terminals as indicated. The trick is to lay out leads to all of the components, in straightforward fashion, without jumping through to the other side of the board, or using any of the other tricks sometimes seen in printed circuits.—*Rene E. Pittet, Jr.*

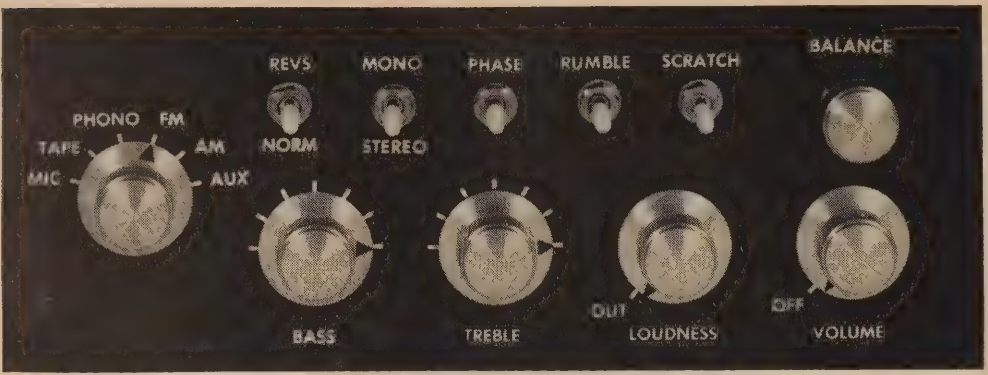


Distribution Problem

Here is a simple series-parallel circuit which might be found in practical work. Enough values are given to make it possible to discover the others. Do you think you can work it?—*Cpl. David B. Schulz* END



STEREO PREAMP Has EVERYTHING



Part II—Features and specs of this unusual all-transistor unit

By
DANIEL MEYER*

LAST MONTH WE SHOWED YOU HOW TO build a superior hi-fi stereo preamp. Now let's take a closer look at the unit and how it operates.

The preamp is built around two high-gain direct-coupled amplifiers (see schematic in the October issue). Dc feedback from the second transistor's emitter to the first transistor's base insures temperature stability, while ac feedback taken from the second-stage collector to the first-stage emitter gives the input impedance needed and helps reduce distortion. By switching suitable R-C networks into the ac feedback loop, we get the compensation needed for the magnetic phono and tape inputs. In all other positions, the preamp response is flat.

The high-level inputs have attenuators and all signals are fed to V1's base by the selector switch. This simplifies input switching considerably and has no noticeable effect on either the distortion or noise. The selector switch shorts all unused inputs so there will be no chance of cross-talk even if other inputs are not turned off. The AUX input jack does not have a level control, but one could be added. If used, it would be connected in the same way as the level controls for the AM and FM inputs. *Do not attempt to improve on the input attenuator circuit by wiring the level controls as potentiometers instead of rheostats as shown.* If this is done, the noise level will depend on the setting of the control and will quickly become excessive as the control is advanced to increase amplification.

The amplifier circuit has a gain of approximately 50 db with the ac feedback loop disconnected. The high open-loop gain also leaves approximately 6 to 8 db of negative feedback still in the circuit at frequencies below 50 cycles. This holds down distortion and insures that phono and tape compensation will be correct and not fall off at low frequencies. Fig. 1 shows the measured deviation from the standard RIAA curve on each channel. The phono compensation was designed to be correct when V1 and V2 have a beta range of 50 to 90. The betas of the transistors in the rest of the circuit are not critical and any transistor of the type specified should be satisfactory. The input impedance in the phono position is approximately 100,000 ohms. If your cartridge requires a lower terminating resistance for proper high-frequency response, connect a resistor across the phono input jack to bring the input resistance down to the correct value. The shunt resistor value needed for various input resistances is shown in the table.

The various feedback networks are switched by a second wafer on the input selector switch. The switch specified can have as many as ten positions so more inputs than the six shown may be added. Monaural operation and channel reversing are switched in or out with two toggle switches wired between the input selector and V1's base. Either or both may be omitted. Slide switches are usually used for this type of switching, but toggle switches are easier to mount, more reliable, and also look better.

Tone controls

The preamp output feeds a step type passive tone-control network. Such a system is usually found in only the most expensive equipment because of the increased number of parts and the additional wiring. This type of tone control has a number of advantages. First, you can be certain that the response is flat when the control is

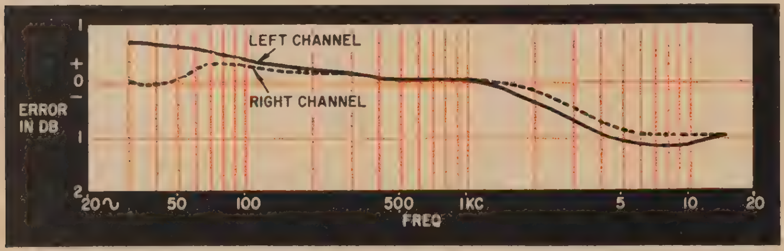


Fig. 1—Measured deviation from standard RIAA curve.

Cartridge Terminating Resistance needed	*Resistance to be added across input*
100K	none
47K	47K
27K	39K

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* Research engineer, Southwest Research Institute, San Antonio, Texas.

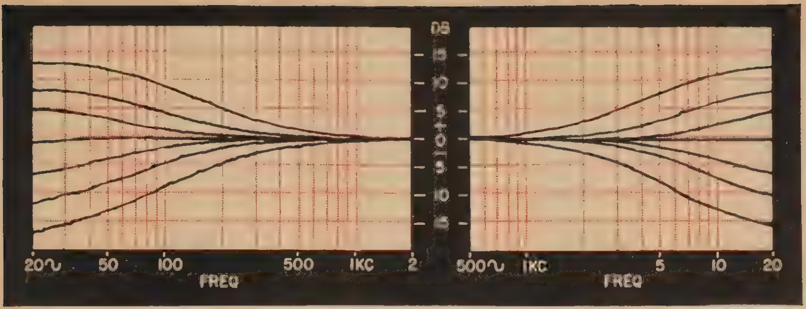


Fig. 2 (left)—Bass tone control response. Fig. 3 (right)—Treble tone control response.

switched to the flat or zero compensation position. Second, you can be certain of the exact amount of compensation being used and can reset this amount exactly. Each step on these controls provides approximately a 4-db change at 50 cycles for the BASS control and at 10,000 cycles for the TREBLE control. A smaller change could hardly be noticed, so no one should miss the fact that settings between these steps are not possible.

The curves in Figs. 2 and 3 show the range of compensation available with these tone controls. Notice that the controls are of the variable-turnover type rather than the less desirable but simpler to build variable-slope type. The BASS curves are actually better than they appear. The 1-db drop at the low end was caused by the sweep oscillator used to trace the curves. The symmetry and precision of the tone-control response depend on the component values being correct. For this reason, 5% tolerance parts are used in the tone-control networks.

The tone controls work into the LOUDNESS–BALANCE–VOLUME system. Typical loudness compensation curves are shown in Fig. 4. A switch on the rear of the control removes loudness compensation completely when the control is turned fully counter clockwise. The BALANCE control can reduce the volume on either channel to zero, but causes little loss when set to its mid-range position (3 db). This is due to the use of complementary log tapers on its two sections.

The volume control works into the second amplifier unit. This two-stage amplifier is almost identical to the preamp. It gives the gain needed to provide an output level that will drive a power amplifier. This second amplifier (V4) drives the rumble filter, scratch filter and phase inverter, if they are included in the preamp. The filters have a 12-db-per-octave slope starting at 60 cycles for the rumble filter and 6,000 cycles for the scratch filter.

The fast cutoff rate allows the rumble filter to remove most of the rumble without damaging low-frequency response seriously. In most cases, it would be hard to tell by listening to the music that this filter was being used. Only on the highest quality speakers, and on music with a great deal of low-frequency sound such as organ music, will the effect of this filter be noticed by many people.

The scratch filter was designed to be used with old or worn records, weak and noisy FM reception, etc. Its effect is not nearly as subtle as that of the rumble filter, but the results are desirable where there is much noise and little or no high-frequency information being received.

Figs. 5 and 6 show the response with the rumble and scratch filters in circuit. The phase-reversal circuit is used on only one channel and introduces a 180° phase shift in it. This control is not absolutely necessary and may be left out, but it can be very handy for checking or correcting speaker phasing. The filters and the phasing circuit have unity gain and low distortion due to the large amounts of degenerative feedback used. They do not affect the gain of the preamp when they are switched into or out of the circuit.

An extra jack is provided on the back panel for a mixed center-channel output if this is desired. A level control for this channel may be installed on the back of the preamp if there is no gain control on the power amplifier used for the center channel. The output at this jack will be R + L, when the PHASE switch is in one position and R − L in the other.

Power supply

The preamp requires 12 volts dc at 15 ma. This may be obtained from other equipment, batteries or an ac supply. For the lowest hum level, use batteries. A pair of 6-volt lantern batteries connected in series will run the preamp for 6 months to a year with an average amount of use. If you prefer an ac supply, use the circuit in Fig. 7.

Testing and use

Connect the power supply and check the preamp for proper operation. If

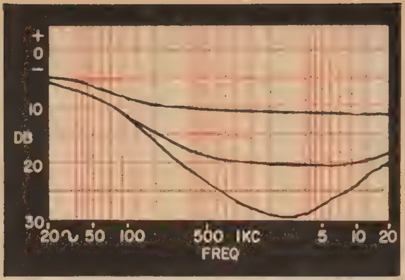


Fig. 4—Typical response of loudness control.

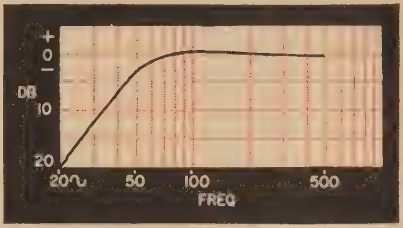


Fig. 5—Response with rumble filter in circuit.

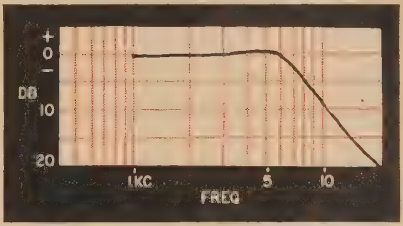


Fig. 6—Response with scratch filter in circuit.

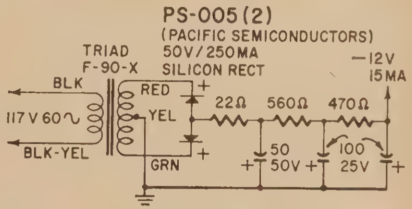
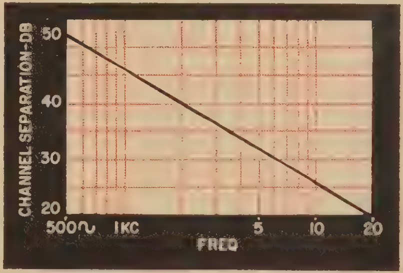
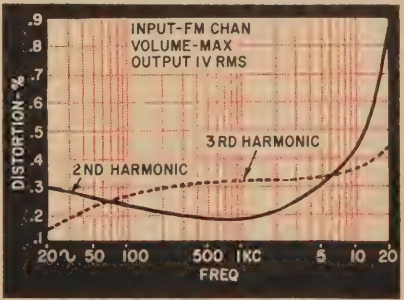


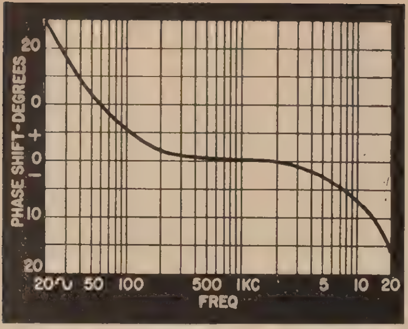
Fig. 7—Ac power supply for the preamp.



Channel separation vs frequency.



Harmonic distortion vs frequency.



Phase response.

operation is not proper, check the wiring and transistor voltages. See table on page 48 of the October issue. It gives the voltages at the transistors. These should not be taken as exact values, since a 10 to 20% variation could occur due to component tolerances without causing trouble. If this check fails to turn up the trouble try signal tracing with an audio oscillator and detector. This is done by connecting the oscillator to one of the inputs and tracing the signal through the circuits with an .oscilloscope, ac voltmeter or head-

The preamp may now be installed in the equipment cabinet. Choose a spot that is not directly over a power amplifier or other component that produces a large amount of heat. The heat will not affect preamp operation, but will dry out the electrolytic capacitors. To keep hum down, it would also be wise to avoid locations near power transformers or turntable motors.

Connect the cables from the sources to be used to the input jacks and from the power amplifiers to the output jacks. Set the level controls to give the same output on AM and FM as in the PHONO position. Connect the amplifiers and speakers so that right- and left-channel outputs are correct with the reversing switch in the NORM position. Speaker phasing can be checked by facing the speakers toward each other, placing them about 4 to 6 inches apart, and playing a record. If throwing the phase switch produces more bass output from the speakers, the phasing is wrong and the wires to one speaker should be reversed. Set the VOLUME control fully clockwise, and the BALANCE control to 50% of rotation. Play a recording and set the level controls on the power amplifiers to produce the highest sound level that will ever be needed. Now turn down the gain on the preamp and check the speakers for equal output. If one is lower, turn the gain on that power amplifier up slightly until both speakers have equal output.

You should be ready now to make that most enjoyable of all tests called a listening test. Put on one of your favorite records, settle down in a good listening spot between the speakers and enjoy the music. END

SW PROPAGATION FORECAST

Oct. 15–Nov. 15

By STANLEY LEINWOLL†

The Central Radio Propagation Laboratory (CRPL) of the National Bureau of Standards is the principal government agency for gathering, analyzing and distributing information about the propagation of radio waves along the surface of the earth, in the atmosphere and through space. It seeks to develop new techniques to utilize and conserve the radio spectrum more efficiently by:

1. Conducting basic research on the nature of radio waves, the nature of the media through which radio waves travel, the interaction of radio waves with these media, and the nature of radio noise and interference effects.

2. Performing scientific research for the development of techniques for more efficient use of the rf spectrum and coordinating these studies with those of other government agencies and private industry.

3. Furnishing advisory and consultative service on radio-wave propagation, frequency management techniques and radio systems problems to other US organizations, public as well as private.

4. Preparing and issuing predictions of propagation conditions throughout the world up to 3 months in advance and providing a warning service warning users of the hf spectrum when disturbed ionospheric conditions are most likely to disrupt communications.

5. Exchanging propagation data with other countries to further knowledge of radio-wave propagation.

Since the range of its scientific activity is rather broad, the CRPL is divided into four divisions: Ionospheric Research and Propagation, Radio Propagation Engineering, Radio Systems, and Upper Atmosphere and Space Physics. In the months to come we will discuss each of them in relation to users of the hf spectrum.

The tables show the optimum frequency in mc for propagation of short-wave signals between locations shown during time periods indicated.

Select the table most suitable for your location, read down the left side to the region in which you are interested, follow the line to the right until you are under the appropriate time. (Time is given in 2-hour intervals from midnight to 10 pm, in your local standard time.) This figure is the optimum working frequency, in mc. The best band is the one nearest the optimum working frequency.

EASTERN US to:	Mid	2	4	6	8	10	Noon	2	4	6	8	10
West Europe	6	6	6	9	20	22	22	15	10	8	7	7
East Europe	6	6	6	8	18	20	14	9	8	7	7	6
Central America	12	11	10	17	22	22	24	26	26	21	13	12
South America	10	10	8	10	22	22	22	24	21	17	13	11
Near East	6	6	6	9	20	20	14	11	10	9	9	7
North Africa	8	6	6	11	22	25	21	17	11	10	10	9
South & Central Africa	8	8	8	16	24	25	24	23	19	14	10	8
Far East	8	8	7	7	8	7	8	7	8	13	13	9
Australia & New Zealand	10	9	8	8	13	12	16	20	22	21	15	12
CENTRAL US to:												
West Europe	6	7	7	8	20	22	14	10	8	7	6	6
East Europe	7	7	7	9	15	12	9	8	8	8	8	7
Central America	12	10	9	17	22	22	23	26	26	21	13	12
South America	10	9	8	18	23	23	23	22	19	15	11	10
Near East	8	7	7	9	16	14	10	9	9	8	7	7
North Africa	7	7	7	10	21	23	15	11	9	8	8	7
South & Central Africa	9	8	7	16	23	26	26	25	20	14	11	10
Far East	7	6	6	6	8	8	7	9	21	21	11	8
Australia & New Zealand	11	10	9	8	13	17	21	24	24	21	15	12
WESTERN US to:												
West Europe	6	7	7	8	18	16	10	9	7	7	6	6
East Europe	8	7	7	7	13	9	9	9	9	9	8	8
Central America	10	9	9	18	22	22	25	25	26	21	13	12
South America	10	9	8	18	25	21	21	21	19	14	11	11
North Africa	8	7	6	10	19	18	13	9	8	7	7	6
South & Central Africa	8	7	7	16	24	24	23	20	17	13	10	10
Far East	7	7	7	6	7	8	8	18	25	20	12	8
South Asia	6	6	5	5	7	11	11	9	15	18	12	7
Australia & New Zealand	12	10	7	6	14	20	24	25	25	24	17	13

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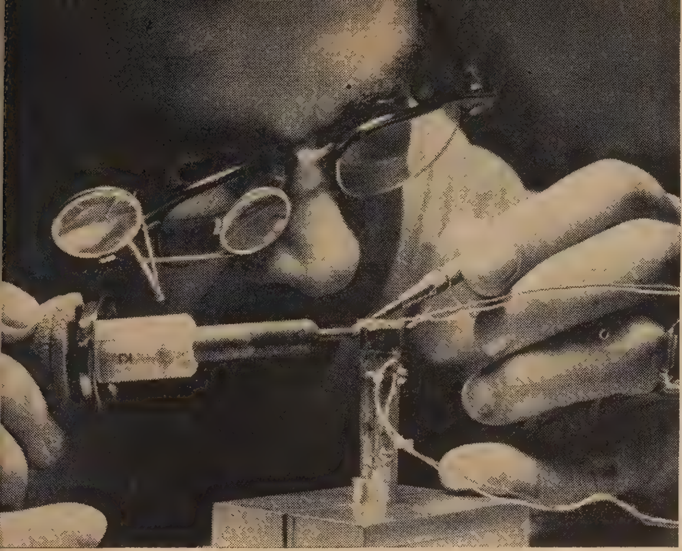
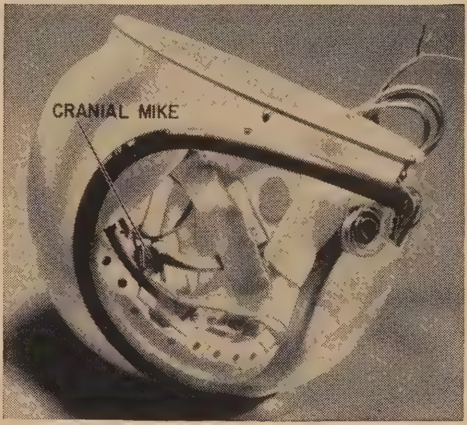
† Radio-frequency and propagation manager, Radio Free Europe.

What's New



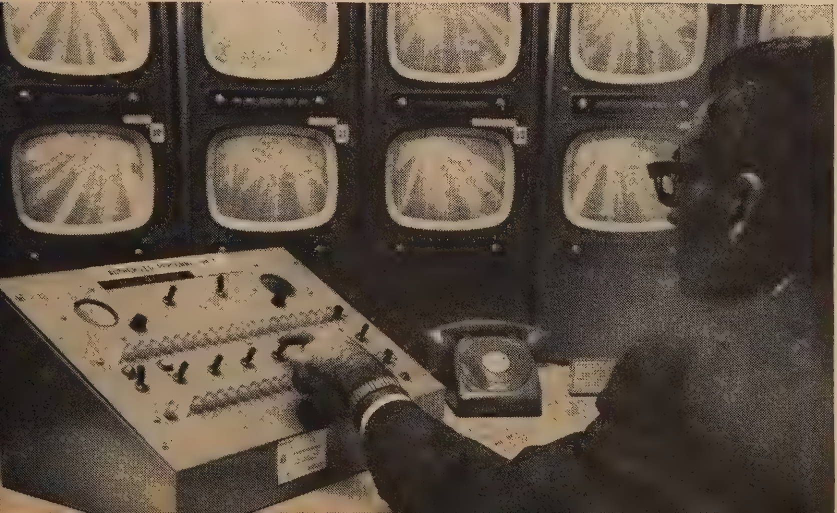
LILLIPUTIAN REFRIGERATOR, atop the plastic column, improves sensitivity of military infrared detectors by keeping their operating temperature low. The detector's noise level drops with temperature. Westinghouse Astroelectronics Lab is the home of this device. It is being wired to a power supply here.



CRANIAL MICROPHONE for radiation protection suit helmet picks up and amplifies high-intelligibility speech direct from the cranial vibrations of the user. Mounting on a leaf spring in the top of the helmet assures constant pressure on the head, no matter how the helmet moves. The system was developed by Dyna Magnetic Devices Inc.

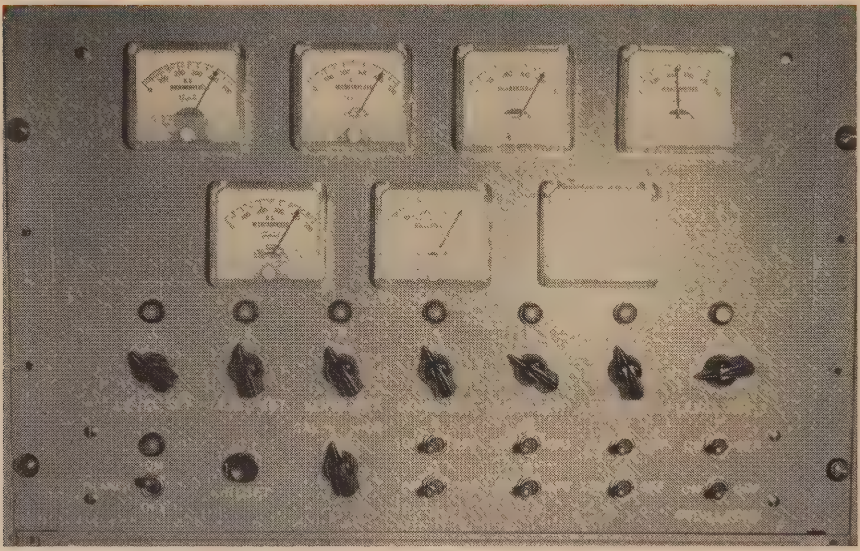
10-FOOT MICROWAVE DISH is a link in 305-mile system bringing TV from Phoenix, Ariz., to KOAT-TV in Alburquerque, N.M. Designed and built by RCA, automatic fault reporting and switching gear insures continuous operation, even if some part of the system should fail.

LAZER PUNCHES HOLE IN A DIAMOND at G-E's Engineer Lab in Schenectady, N.Y. It takes only 200 microseconds to cut, and the impact of the laser beam generates temperatures around 10,000° F. The flame and smoke is actually vaporized diamond particles. *UPI*



TV MOVES TRAFFIC on Detroit's 6-lane John C. Lodge Freeway. The controller scans 14 TV screens which show him 14 points along the freeway. At any sign of trouble — accidents, traffic jams, etc. — he can correct the problem by remotely reducing speed limits, closing lanes or closing entrance ramps. The system was built by G-E for the Michigan State Highway Department.

magnetic tape tester finds the dead spots



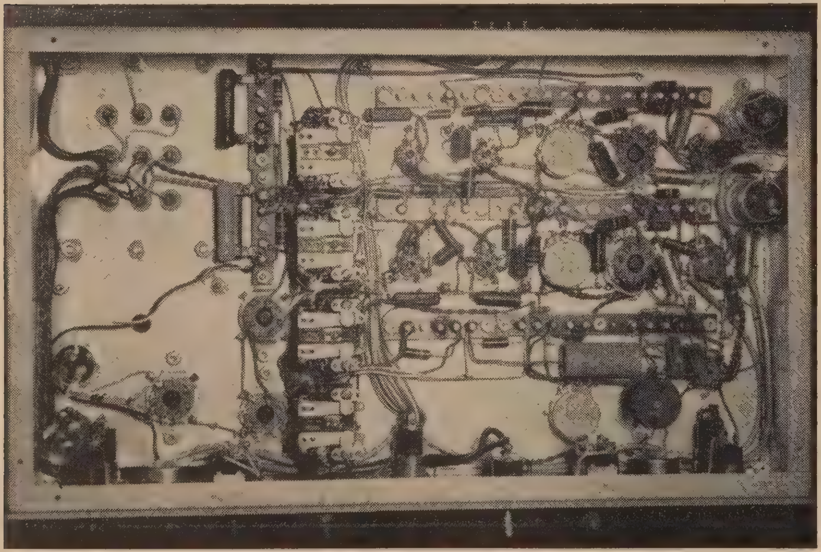
Automatic device locates and counts dropouts on multichannel recording tape

By DON WHERRY

How can we test for the quality of the magnetic coating on a reel of tape? Particularly, how can we find and mark sections of the coating that will not record at the proper level, sections that cause dropouts? If a dropout is large (the area affected along the length of the tape) it will be discernible to the audiophile who records off the air. But even more important are the smaller dropouts that can ruin the telemetered results of an expensive series of missile tests or cause loss of sync in the middle of a taped TV show.

Such reductions in magnetic tape output can be caused by extremely small foreign objects mixed with the original iron-oxide coating; dust particles which have impinged on the tape surface during previous recording sessions; slight faults in the tape which cause oxide flaking; and rough handling. The dropouts can vary from a fraction of a db to complete absence of recorded signal, and extend for a minute section to several feet of the tape track.

A relatively simple instrument that will locate such dropouts is described here. The photos show two such devices. One is for ¼-inch 2-track tape and the other for ½-inch 7-track tape. Both are identical except for the number of channels available. Because the 2-track instrument is electrically equivalent to the 7-track model, the circuit and description cover only the 2-track instrument.



Parts layout under chassis for tester shown in Fig. 1.

Basically the unit compares the output voltage of the tape under test to a standard reference voltage. When the tape output drops below this reference level for a sufficient length of time (both reference level and time are adjustable), we get a visual indication of dropout and the tape transport stops.

The test voltage from the tape is from a 10,000-cycle pre-recorded audio tone. For commercial recorders the tone is recorded simultaneously with the test run; for smaller home recorders, the tone is recorded prior to making the test.

How it works

The signal is picked up by a playback head and enters the instrument through an input jack and the CALIBRATH-OPERATE switch (see Fig. 1). The signal level then is set by the INPUT GAIN potentiometer and amplified by V1-a and V1-b. This audio signal (10 kc) is then rectified by V2-a and

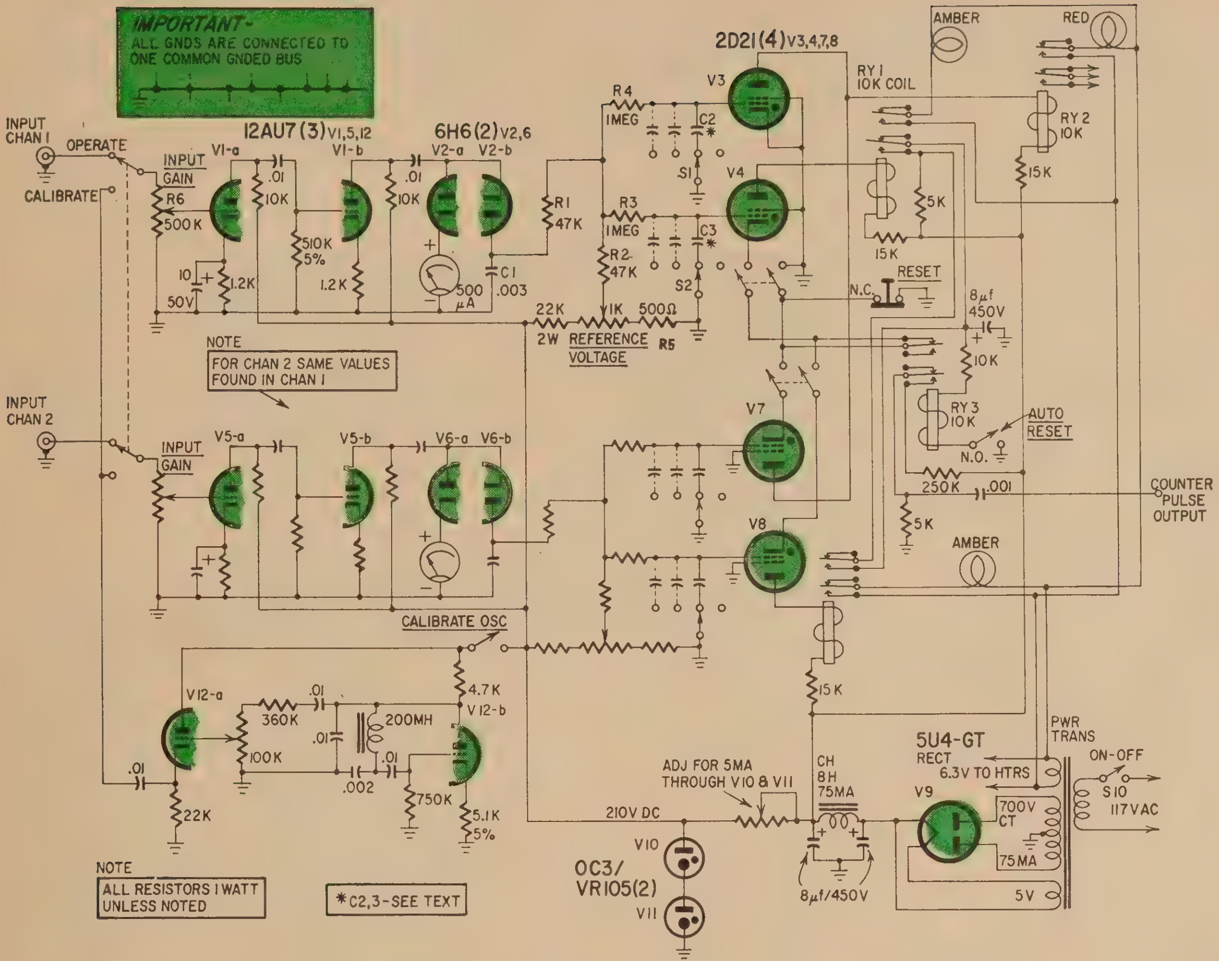

IMPORTANT-
ALL GNDS ARE CONNECTED TO ONE COMMON GNDED BUS
INPUT CHAN I
OPERATE
CALIBRATE
12AU7(3)V1,5,12
V1-a
V1-b
INPUT GAIN
R6
500K
.01
10K
510K 5%
1.2K
10
50V
6H6(2)V2,6
V2-a
V2-b
500 μA
C1 .003
R1 47K
R4 IMEG
C2
S1
R3 IMEG
R2 47K
C3
S2
22K
2W
1K
500Ω
REFERENCE VOLTAGE
R5
2D21(4)V3,4,7,8
V3
V4
RY I 10K COIL
AMBER
RED
RY 2 10K
15K
5K
RESET
N.C.
8μf 450V
RY 3 10K
AUTO RESET
N.O.
250K
.001
COUNTER PULSE OUTPUT
NOTE
FOR CHAN 2 SAME VALUES FOUND IN CHAN I
INPUT CHAN 2
V5-a
V5-b
V6-a
V6-b
V7
V8
CALIBRATE OSC
4.7K
V12-a
V12-b
360K
100K
200MH
750K
5.1K 5%
.002
22K
ADJ FOR 5MA THROUGH V10 & V11
210V DC
V10
OC3/ VR105(2)
V11
CH 8H 75MA
8μf/450V
5U4-GT RECT
6.3V TO HTRS
V9
700V CT
75MA
5V
PWR TRANS
ON-OFF
S10
117VAC
NOTE
ALL RESISTORS I WATT UNLESS NOTED
*C2,3-SEE TEXT

Fig. 1—Circuit of a 2-channel unit. If more channels are to be tested simultaneously, duplicate test channels can be added. There is no limit to their number.

V2-b in a voltage-doubling circuit. The current through V2-a is observed on the 500-μa meter between its cathode and the ground and is used to set the input signal to a predetermined level. The negative voltage developed at V2-b's plate is fed through 47,000-ohm resistor R1 to the junction of R2, R3 and R4. Here it is compared with the positive voltage set by potentiometer R5.

This positive voltage is adjusted to give the desired dropout indication when the normal tape output level falls below a given value. This means that with normal signal input, the junction of R1 and R2 is at some negative potential. The grids of V3 and V4 are also at this negative voltage and the tubes are cut off. Now when the head reaches a dropout on the tape, the negative voltage from V2 drops, lowering the negative grid voltage on thyratrons V3 and V4 until they ionize. This happens if the dropout is greater than what was set in by R5.

A more detailed setup procedure follows: The signal from the tape under test is fed into the unit to give some arbitrary reading on the level meter—say 400 μa. The signal input to the instrument is then reduced by the amount decided upon as the maximum reduction in tape output allowable without the reduction being called a dropout, in this case 5 db. The positive voltage from R5 is then increased until V3 and V4 just ionize. This means that the output from the tape can drop any value up to 5 db with no indication from the instrument. However, if the dropout is greater than 5 db the thyratrons will ionize, indicating a dropout which exceeds the allowable maximum. It can be seen that by properly adjusting the input potentiometer R6 and the REFERENCE VOLTAGE potentiometer R5 a wide range of dropout indication levels may be set into the instrument.

Up to this point we have discussed dropout levels only, with no reference to their lengths. If nothing is done regarding length, any dropout whose length exceeds the ionization time of V3 and V4 will trigger the instrument (time modified slightly by C1). This is not what we want. We want some value of time to also enter the picture, therefore we have added 1-megohm resistors R3 and R4 and capacitors C1 and C2 between the voltage comparison point and the thyratron tube grids. The discharge time of this RC combination determines the length of dropout that will trigger the instrument. The discharge time may be calculated by using the formula for time constants. However, the time calculated is not necessarily the discharge time needed to ionize the thyratrons. This can be found only by measurement. Place a vtvm on the grid of the thyratron and measure the normal negative grid voltage, then reduce the signal input slowly until the tubes just ionize. These two voltages may then be applied to a discharge curve (time constant curve) and the true time is found for a given value of C2 and C3. It may sound complicated but it really isn't.

For the home recorder owner who does not need such accuracy, an easier method is to record a tone (audio oscilator, whistle or just music) on a section of tape; then cut the tape and splice it together again leaving a small gap between the tape ends. Adjust this gap width until it is just audible when the tape is played back, then adjust C2 and C3 until the thyratrons ionize with a gap slightly smaller. Capacitors, both smaller and larger, may be added to switch circuit S1 and S2 for tighter or looser standards. The home recorder can dispense with this switch altogether, and use only the one capacitor whose value was found by ear.

In the instrument in Fig. 1, V3 and V4 are controlled by different time constants. V4 is set for 13 milliseconds and V3 for 100 milliseconds—both at

5-db depth. This circuit is a form of integrator. The deeper the dropout level, the faster the trigger action on the thyratron. This means that, while a dropout slightly exceeding the 5-db threshold level will trigger V4 in 13 milliseconds, a dropout of, say, 25 db will trigger much faster. This allows the instrument to evaluate the seriousness of the defect. A perfect tape—one without any dropouts—is extremely rare, even among new tapes of the best obtainable quality. With used tapes, the dropout count increases rapidly, particularly if it has been run many times or stored under unfavorable conditions.

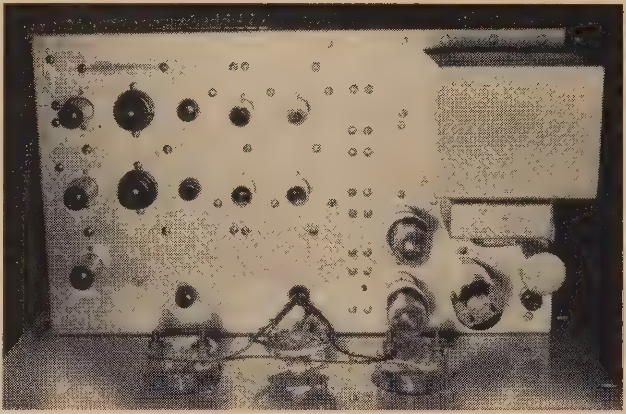
Switching and power supply

When testing new as well as used tape the user must evaluate his requirements and determine just how many dropouts—and to what dropout level he must hold—before rejecting the reel. These criteria are determined by how the tape is to be used. For audio work, either by a professional or a serious amateur, the requirements are not as stringent as they would be for instrumentation work. At this telemetering center it is considered practical to pass as OK magnetic tapes which do contain a limited number of short-term dropouts which exceed the 5-db and 13 milliseconds mentioned, provided they are not clustered in one small area, indicating a faulty or damaged section of the tape. However, if the dropout exceeds 10 milliseconds and triggers the slow time constant channel, it is cause for immediate rejection. This is the reason for having the two channels—both set for the 5-db dropout level.

The plates of V3 and V4 go to ordinary plate relays. One V3 (RY2) lights an indicator light and, being the reject circuit, opens a contact which stops the tape transport when energized. Once closed, this relay remains closed. V4's plate goes to a similar relay, RY1, which upon closing, not only lights an indicator, but starts a reset sequence. This sequence is continued by the plate relay RY1 closing the circuit to another relay, RY3, which in turn opens the cathode of V4. This deionizes the tube and allows the original plate relay to fall out, thereby opening the circuit to the second relay allowing it to fall out and close the cathode of V4, thus resetting the circuit—provided the signal level from the tape has returned to the normal level. The reset relay also furnishes a counter pulse to trigger an external counter for automatic dropout tabulation if desired. If the automatic reset feature is not wanted, the plate circuit of the reset relay may be broken by the auto-reset switch. Once triggered the instrument then remains in that condition until the manual reset button is depressed to allow the thyratrons to de-ionize. This resets the circuit. The push-button resets all thyratron tubes in the instrument, not just individual ones.

The plate relay for V3 is common with V7. All channels have this common plate relay in the slow time constant circuit, and all channels have a common reset relay in the fast circuit. This is also true of the 7-track instrument.

The power supply needs no comment except to mention the fact that the voltage to the amplifiers and potentiometer controlling the reference voltage must be regulated to insure reliability in the tests. The remaining circuit is the audio calibrate oscillator. It furnishes a signal input of constant level for the setup procedures and performs periodic checks on the dropout level adjustments, etc. Any type of audio oscillator circuit will operate equally well.



Top chassis view of the 2-channel tape tester.

While the external counter adds the dropout from all tracks, visual observation of the indicator lights while the unit is in operation allows the operator to record the dropouts from any, or all, channels separately if desired.

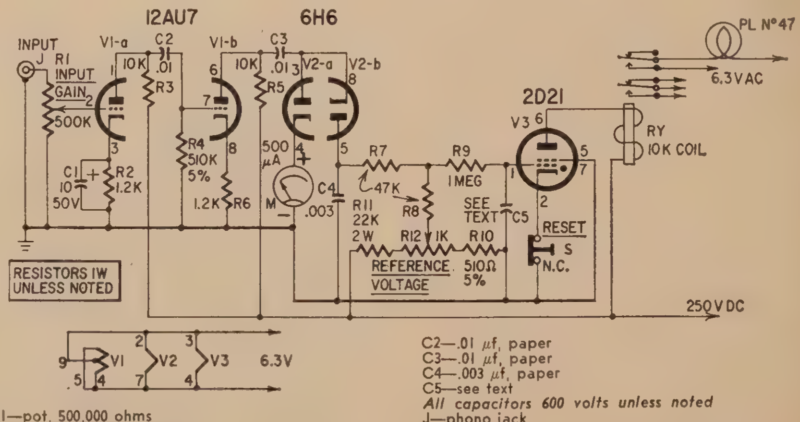
Construction tips

The cost of constructing this unit is not great. The home recording enthusiast will probably limit his unit to a single track instrument. Even the circuit shown, with one track left out, is likely to be more complicated than the average user of the home tape recorder would wish. Fig. 2 shows a single-track tester which will do everything necessary for ordinary audio work. It uses only one thyratron channel whose dropout "time" is set by ear, as outlined earlier. Even the dropout depth can be set without instruments. With an indicated 400 µa set on the level meter as the normal input level, 200 µa on the meter is approximately 6 db. It is the one to use for testing ordinary audio only tapes.

No special care, or order, is needed in the chassis layout. Good audio practices are all that are necessary. A suggested layout is shown in the photos.

Anyone who takes his magnetic recording seriously, whether it's Tchaikovsky, Junior's first word, or broadcast programming, should have some way of testing tape—especially when the "bargain" price product is used.

This unit is a proven instrument which can be used to test magnetic recording tape to conform to any desired quality for any ultimate use. END



R1—pot, 500,000 ohms
R2, R6—1,200 ohms, 1 watt
R3—10,000 ohms, 1 watt
R4—510,000 ohms, 1 watt, 5%
R5—10,000 ohms, 1 watt
R7, R8—47,000 ohms, 1 watt
R9—1 megohm, 1 watt
R10—510 ohms, 1 watt, 5%
R11—22,000 ohms, 2 watts
R12—pot, 1,000 ohms
All resistors 10% unless noted
C1—10 µf, 50 volts, electrolytic
C2—.01 µf, paper
C3—.01 µf, paper
C4—.003 µf, paper
C5—see text
All capacitors 600 volts unless noted
J—phono jack
M—500 µa dc
PL—No. 47 pilot lamp and mounting assembly
RY—10,000 ohm coil, dpdt contacts
S—spst pushbutton, normally closed
V1—12AU7
V2—6H6
V3—2D21
Socket, 9-pin miniature
Sockets, octal (2)
Case, to suit
Miscellaneous hardware

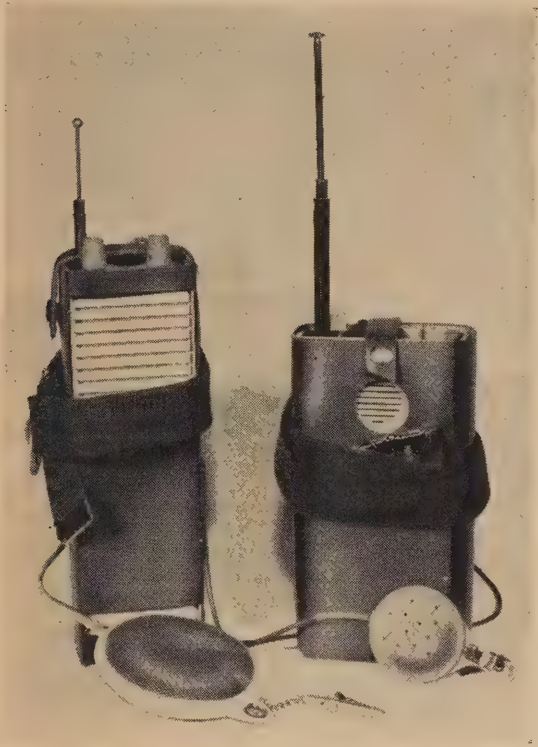
Fig. 2—This simplified unit can be used by the audiophile to check his audio tapes.

CB PHOTONOTES

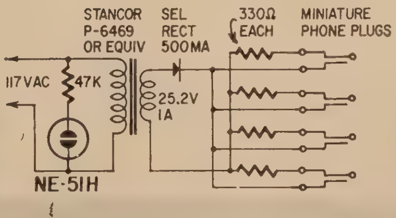
Here are three gimmicks that make class-D CB equipment easier to use and quicker to service

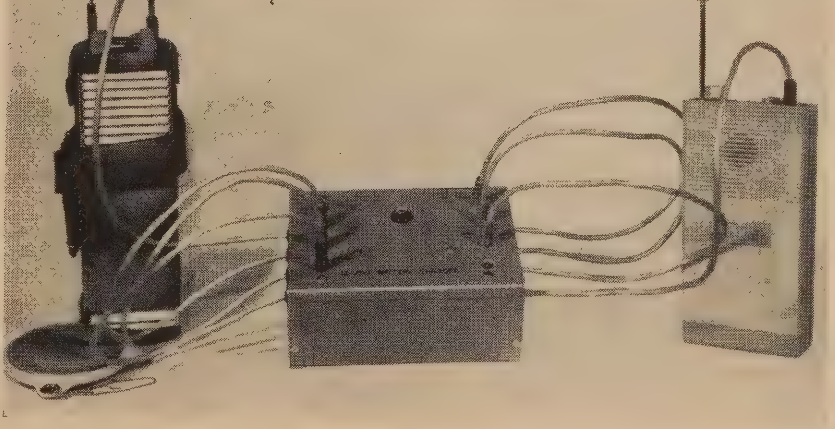
By **R. L. WINKLEPLECK**

The service shop often has to connect several makes of CB gear interchangeably to the shop antenna. If the antenna lead-in terminates in a conventional phono plug and this adapter is used, there is never a problem. The Switchcraft phono jack shown at the left can be fitted into the Amphenol UG-175/U fitting tapped for the ¼ x 32 threads and this screwed into the PL-259 plug. A short length of wire connects the center terminals.

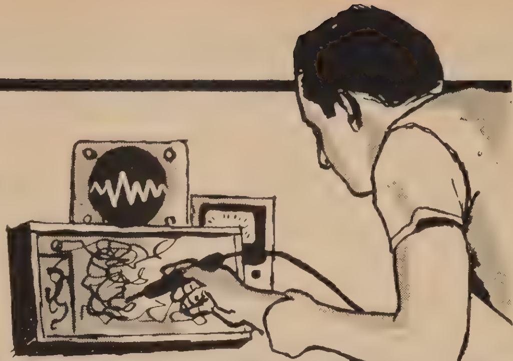


CB units, like the ones shown here can be easily adapted to be belt-worn for convenience. Lapel speaker mikes complete the outfit. The carrying case for the unit on the right was hand-fashioned. The lapel speaker mike is a small pillow speaker.





When CB transceivers are used commercially, rechargeable batteries become a must. This charger (see diagram) for nickel-cadmium cells contains a standard 25-volt filament transformer and a silicon rectifier. A 330-ohm resistor in each charging lead limits charging current to the 12-volt batteries to 20 ma maximum. Miniature plugs fit the jacks on the CB transceivers. Charger plugs are plugged into the insulated holes on the charger when not in use and a neon lamp shows when the charger is on.



SERVICE CLINIC

By JACK DARR
SERVICE EDITOR

This column is for your service questions. We answer them free of charge and your name and address will be kept confidential if you wish. The main purpose is to help those working in electronics with their problems.

We've changed our target a little and are no longer restricted to TV, Radio, audio and industrial electronics problems are also grist for the mill. All letters get a prompt individual answer and the more interesting ones will be printed here. So if you have a service problem, send it here. We'll do our very best to help you solve it.

ALMOST ALL TV TROUBLES ORIGINATE IN the receiver. However, there is always the possibility that they are originating in the transmitter! This should be remembered by the technician, to save useless testing time.

TV transmitters operate within very strict tolerances set up by the FCC, and engineers watch them very closely. However, errors can creep in, through defects in equipment, accidents, or a moment's inattention on the part of the engineer on duty!

The proportion of video signal to sync tips is what gives receiver technicians the most trouble. Under FCC reg's, this must always be 75% video, 25% sync, as seen in Fig. 1. This pattern is displayed on a monitor scope on the control panel, and should be watched by the operator at all times.

However, if the monitor is not correctly calibrated, the sync percentage can be off, even though the console scope shows it at the right value. The input to this monitor is usually taken off at the transmitter's output, through a diode probe inserted in the transmission line (Fig. 2).

During remote operation, sync percentages of the signal being sent to the transmitter (over a microwave link or coaxial cable) are monitored, and should be monitored once more at the transmitter site. The calibration of these scopes is checked at regular intervals, when "proof of performance tests" are made on the transmitter, for reporting to the FCC.

Two symptoms of this trouble show up in the TV receiver—instability, especially in the vertical sync, and excessive contrast, due to the high video level. This is easily detected on a community antenna system or in a location where two or more stations can be received with about the same signal strength. Set the receiver for a normal picture on one channel, then switch to the others. If all other channels but one have good contrast and sync and the one bad station shows *both* weak sync and excessive contrast (a much blacker picture), you've reason to suspect transmitter troubles!

The best test is to measure the proportion of sync to video, using an oscilloscope and low-capacitance probe, on a TV set known to be in good operating condition. Set up the equipment and tune the set to a channel producing a good picture. Use the video amplifier input or output as the point of connection, whichever gives the best scope pattern with the least disturbance to the picture itself. Now, tune from the suspected channel to the others, and note the percentage of sync to video shown up on the scope. For the most accurate results, adjust the rf signal input to the set to the same level on both channels. If one is quite a bit stronger than the rest, there is always the possibility that the agc may be causing clipping in the receiver. Signal adjustments can be made with simple resistive pads, or a broad-band adjustable-gain booster may be used.

Fig. 3 shows the differences that can be found if there actually is trouble in the transmitter. Be very sure that the comparisons made are accurate. The remedy is to notify the chief engineer of the station. He will usually be very cooperative about such matters, if approached in the right way!

This trouble can also cause much grief when color TV programs are being transmitted. This will be discussed in another Clinic.

Difficulties can also occur in network transmissions. These are somewhat different in nature from the faults discussed above and will also be covered in another Clinic.

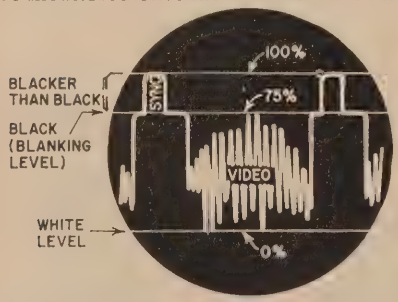


Fig. 1—What the engineer should see on his console scope. Video should never be allowed to go above 75% of the waveform and the sync ranges between 75 to 100%.

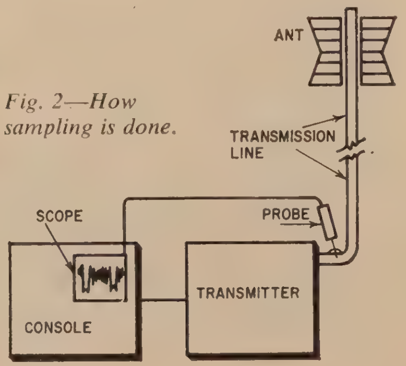
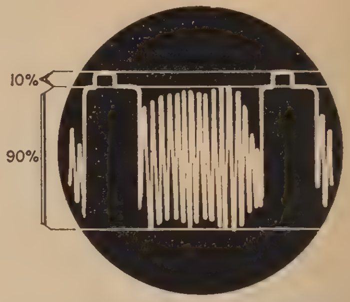
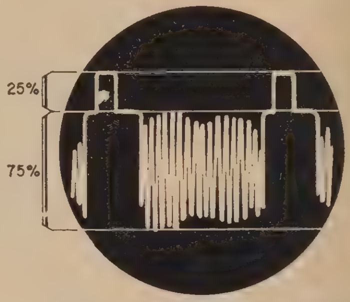


Fig. 2—How sampling is done.



LOW SYNC-VIDEO RATIO (ONE CHANNEL ONLY)



GOOD SYNC-VIDEO RATIO (ALL OTHER CHANNELS)

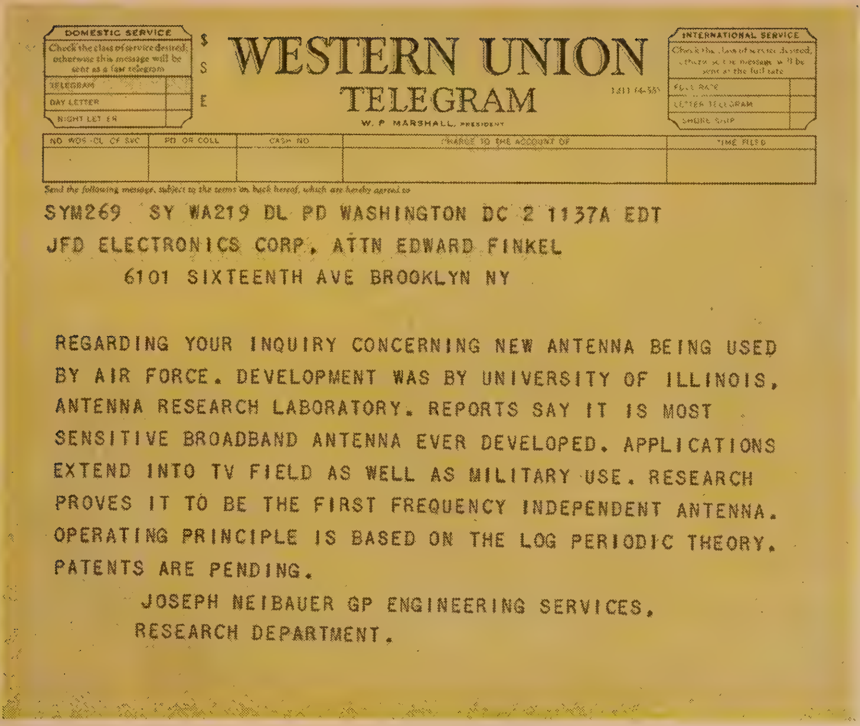
Fig. 3—What you can see if a TV station is actually transmitting an improperly shaped signal compared to good sync–video ratio.

Needs tuner slugs

I've got a CBS 6T303 in my shop. This set was brought back from Japan. The only changes I can see are the tuner slugs replaced. The series-number is DB. In place of 12DB, 13DB, etc.; I have 12TDJ-B and so on. We have channel 2, 12 and 13. I managed to pull 13 in on a 12DB and 11 is OK. I can't find any DB slugs here. Can you tell me where I can get the right slugs for this?—R. F. H., Baltimore, Md.

I've always wondered who started

(Continued on page 60)



DOMESTIC SERVICE

Check the class of service desired; otherwise this message will be sent as a fast telegram

TELEGRAM

DAY LETTER

NIGHT LETTER

$

S

E

WESTERN UNION

TELEGRAM

W. P. MARSHALL, PRESIDENT

INTERNATIONAL SERVICE

Check the class of service desired; otherwise the message will be sent at the full rate

FULL RATE

LETTER TELEGRAM

SHORE SHIP

NO. WDS.-CL. OF SVC.	PD. OR COLL.	CASH NO.	CHARGE TO THE ACCOUNT OF	TIME FILED

Send the following message, subject to the terms on back hereof, which are hereby agreed to

SYM269 SY WA219 DL PD WASHINGTON DC 2 1137A EDT

JFD ELECTRONICS CORP., ATTN EDWARD FINKEL

6101 SIXTEENTH AVE BROOKLYN NY

REGARDING YOUR INQUIRY CONCERNING NEW ANTENNA BEING USED BY AIR FORCE. DEVELOPMENT WAS BY UNIVERSITY OF ILLINOIS, ANTENNA RESEARCH LABORATORY. REPORTS SAY IT IS MOST SENSITIVE BROADBAND ANTENNA EVER DEVELOPED. APPLICATIONS EXTEND INTO TV FIELD AS WELL AS MILITARY USE. RESEARCH PROVES IT TO BE THE FIRST FREQUENCY INDEPENDENT ANTENNA. OPERATING PRINCIPLE IS BASED ON THE LOG PERIODIC THEORY. PATENTS ARE PENDING.

JOSEPH NEIBAUER GP ENGINEERING SERVICES,
RESEARCH DEPARTMENT.

FROM THIS BEGINNING...A NEW ULTIMATE IN TV ANTENNA DESIGN

It was in 1954 that word came out of Urbana, Illinois—the Antenna Research Laboratory of the University of Illinois had "broken through" the bandwidth problem with the log-periodic principle.

Professor Mayes and JFD's Ed Finkel discuss the LPV

The implications were profound: an antenna that would be essentially frequency-independent, that would set new standards in gain, in bandpass, in front-to-back ratio, that would have an "unidirectional pattern with a directivity comparable to a Yagi array" over bandwidths in excess of 20 to 1.

The Air Force began to apply this new concept to its critical outerspace telemetering needs—and, in 1961, JFD Electronics and the University began discussing home-television applications.

When JFD was granted the exclusive rights to develop, produce and market the TV antennas based on this principle, the resources of the world's largest antenna manufacturer were galvanized into action. A special force of engineers and researchers went to work. A succession of working models began to appear atop the 135-foot tower of the JFD Antenna Research and Development Center. Exhaustive tests were undertaken, modifications and refinements made, construction details explored.

Now, as a climax to some eight years of study and development, the first of the log-periodic V antennas is here—fulfilling every promise and presaging a revolution in TV antenna design and performance.

Professor Mayes at antenna research laboratory

University of Illinois Develops Space Age Antenna

The theoretical formulation and extensive research which led to the final development of the LPV antenna was a cooperative effort by several outstanding antenna scientists at the Antenna Research Laboratory of the University of Illinois.

Early recognition of the high caliber and originality of these scientists came from the Air Force which awarded several R & D contracts to the University.

Dr. V. H. Rumsey, who headed the Antenna Research Laboratory from 1954 to 1957, directed a large portion of its efforts towards the quest for frequency independence. Professor Rumsey suggested that a logarithmic spiral of infinite length might have characteristics independent of the frequency of operation. Further research by Professors R. H. DuHamel John D. Dyson, and D. E. Isbell established this theory and also led to the development of a series of finite size antennas which exhibited constant pattern and impedance characteristics independent of frequency over a wide range of frequencies.

The importance of this work soon became obvious with the massive effort devoted by the government to space communications and telemetry. The satellite "Transit" used a modified logarithmic spiral to communicate with our tracking stations from 50 to 400 mc.

In 1957 Professor DuHamel built the first planar Log-Periodic antenna. This was followed in 1959 by Isbell's uniplanar Log-Periodic dipole array. For the next two years, exhaustive tests at the Antenna Research Laboratory were aimed at establishing the properties of the Log-Periodic. It was during this period that Doctors Paul Mayes and R. L. Carrel made their many contributions to the understanding of these antennas and jointly hit upon the V configuration of the dipoles. Tests indicated that this extended the antenna's high directivity from the lowest frequencies covered to the highest.

Professor Mayes subsequently made some modifications in the LPV design so as to make it more suitable for UHF and VHF television coverage.

Revolution in the Air: JFD PRESENTS

nitially Developed by the Antenna Research Laboratories of the University of Illinois*, Proved-Out in Air

T COULD ONLY HAVE BEEN PRODUCED by such massed resources as those of a prominent university, the military, and the country's leading antenna manufacturer.

BECAUSE ITS GAIN IS INDEPENDENT OF FREQUENCY, he backward-wave log-periodic LPV functions with high efficiency across the entire band. This end-fire array is comparable on any channel to a tuned Yagi cut to that channel.

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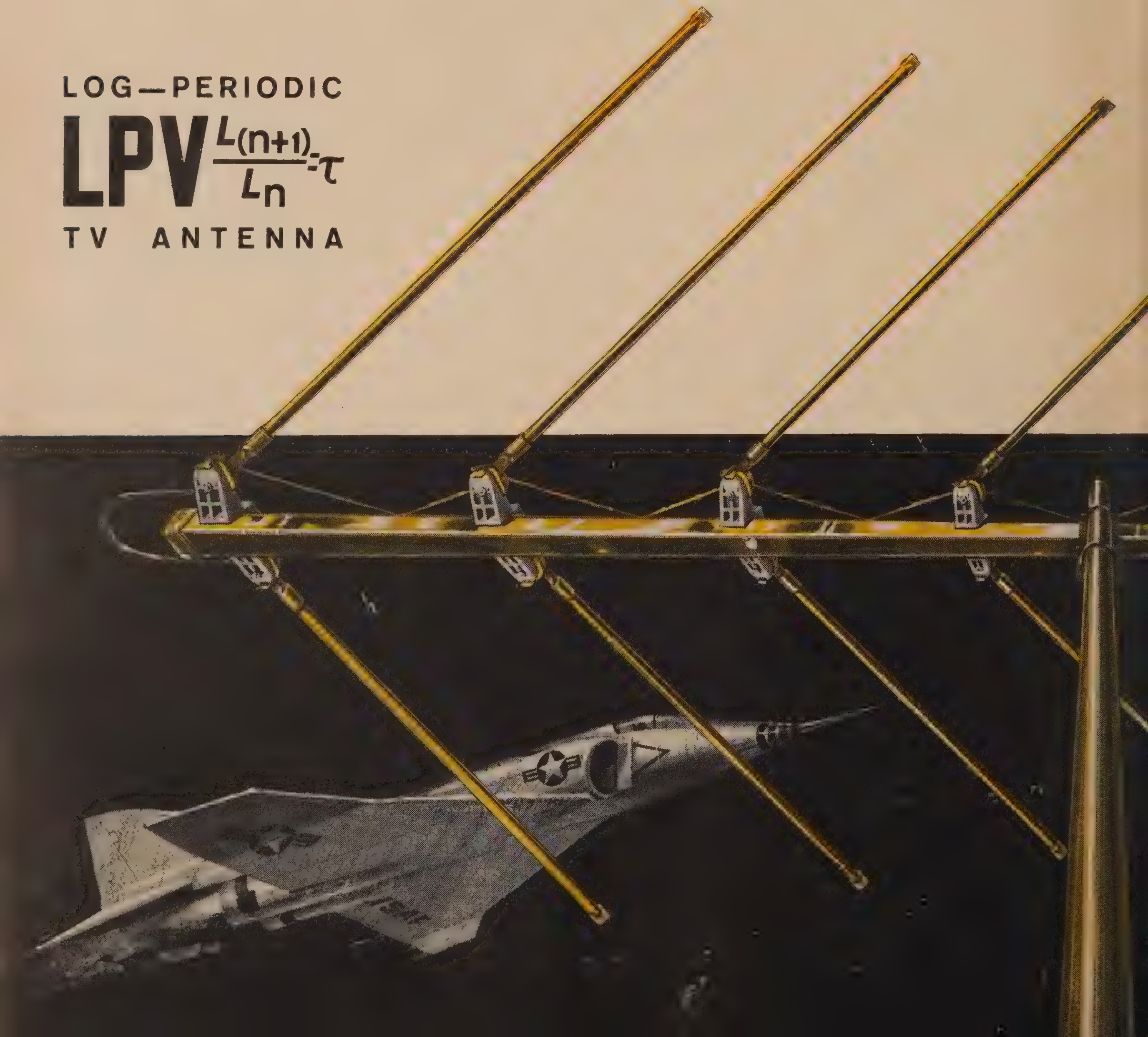
U.S. PATENT NUMBERS 2,958,081—2,985,879—3,011,168 ADDITIONAL PATENTS PENDING

LOG—PERIODIC

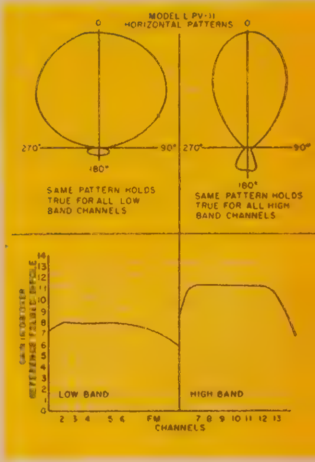
LPV $\frac{L(n+1)}{L_n} = \tau$

TV ANTENNA



THE LOG-PERIODIC LPV

Force Satellite Telemetry, Adapted to TV by JFD—Ending the "Era of Compromise" in TV Antenna Design



NOT A "CATCH-ALL COMPROMISE"—the log-periodic LPV signals a halt to the endless piling-on of narrow-band elements and parasitics. It is essentially frequency-independent since it is derived from an antenna geometry that repeats the electrical properties of the basic element, or cell, periodically; the periodicity being proportional to the logarithm of the frequency. (Actually, the basic log-periodic design is capable of flat response over a frequency range as broad as 20 to 1.)

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Harmonically resonant V-elements operating on the Log-Periodic Cellular Principle in the Fundamental and Third Harmonic Modes:

LPV-4:
4 Active Cells—up to 50 miles

LPV-6:
6 Active Cells—up to 75 miles

LPV-8:
7 Active Cells and 1 director—up to 100 miles

LPV-11:
9 Active Cells and 2 directors—up to 125 miles

LPV-14:
13 Active Cells and 1 director—up to 150 miles

LPV-17:
15 Active Cells and 2 directors—up to 175 miles

Winter
winds
and
weather
getting
you
down?

These articles, in the December issue of Radio-Electronics, will warm the cockles of any electronics hearted careerman or experimenter. You'll find things to do, ways to increase your income, methods of making your hobby interesting and useful. Next month's Radio-Electronics in a word: ELECTRIFYING!

TRY READING THESE SNOW-MELTERS:

"START YOUR CAR FAST" Electronic starter thaws frozen cars. How you can build a 3-transistor unit that provides summer voltage and spark in zero weather.

"9 STEPS TO COLOR" Easy-to-use, step-by-step color TV servicing procedure. You'll want to memorize this one.

"FM STEREO ADAPTER" Convert your monaural FM tuner to multi-dimensional listening by building and using this transistor adapter.

"SHARPLY TUNED AF SIGNAL TRACER" Build this economical multi-use tracer. Unit checks for hum, peaks, dropouts, and many other amplifier defects. Use it also as a wave analyzer, bandpass filter with indicator, null detector, tunable af amplifier and seven other applications.

Radio-Electronics

December Issue on Sale November 19

(Continued from page 56)

calling Standard Coil tuner coils "slugs." Everyone does, including me! Anyhow, the slugs in the tuner you have must be a Japanese special, I can't find them listed anywhere. However, from the information you give, this is a Standard Coil type T tuner. The regular DB slugs will fit it and should be available at parts supply houses.

Vertical linearity is off

I cured the vertical rolling the set came in with. Now I have a vertical linearity trouble left. Linearity is fair at first, then the top of the picture stretches and the bottom compresses. You can keep compensating with the height control. It's a Hotpoint 17S302.—M. P., Tampa, Fla.

This has been quite a problem in this series, and there seem to be several answers. Most of the trouble is caused by minute leakages in capacitors (Fig. 4): the .0039 and .015 in the vertical oscillator are the worst offenders. Also, check that 3.3-megohm plate resistor. It's another good prospect.

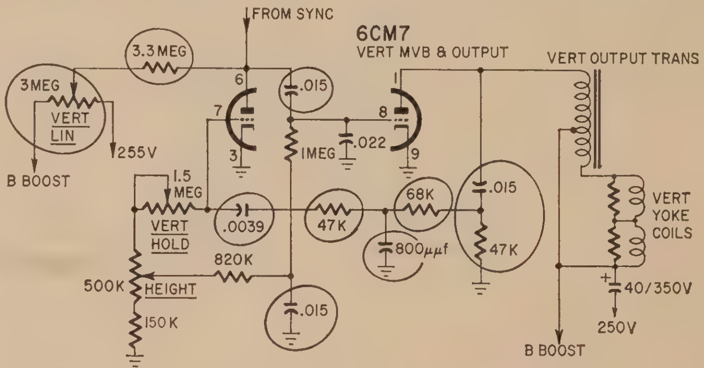

Fig. 4—Vertical oscillator–output circuit in Hotpoint 17S302. Circled parts can cause trouble.

You might change the resistor in series with the vertical linearity control from the present 3.3 to 2.7 megohms. At the same time, check the 1-megohm and 820,000-ohm resistors in the output grid circuit.

Accidental magnetization

One of my customers' color TV sets suddenly jumped out of convergence pretty badly. I checked all of the adjustments, degaussed it, and reconverged it without a bit of trouble! I couldn't find a thing that could have caused it!—E. K. W., Plainfield, N. J.

The only possible answer for this is a thing that I've never encountered personally, but have heard of in several cases—*lightning!* A heavy lightning bolt striking within a certain distance, not striking the set, but hitting nearby, can cause partial demagnetization (or magnetization) of the purity magnets, faceplate, etc. and foul up the convergence. Sort of a gaussing operation. If you found no other troubles, this must be the explanation.

Big tube, small raster

We have just converted on Arkay TV Kit model 14T21 from a 21YP4-A tube to a 21CEP4-A (we also changed the yoke). Now we seem to be lacking sweep. The picture is small, about 8 by 10 inches. The old yoke had four leads, while the new one has five. Does this have anything to do with the small picture?—V. B., Oakland, Calif.

I'm sorry to say that you have apparently bitten off more than you can chew. While you *must* change the yoke to get sufficient scan when converting to a larger picture tube, you must also increase the *power* delivered to the yoke. Thus if you were changing from a 70° to a 90° *tube*, a 90° yoke would not give you full scan unless you increased the *power* delivered to the yoke!

To make this conversion work, you would have to change not only the flyback but the vertical output transformer, both output tubes and probably increase the B-plus voltage. I would not hold out much hope of making a successful conversion when going over this much "distance." Some conversions from 70° to 90° types work out fairly well, but 70° to 110° is quite a jump.

The fifth lead you ask about in the Y-60 Triad yoke is a center-tap lead for the horizontal yoke windings put there as a convenience when replacing this yoke in circuits using the center tap. In a four-lead yoke circuit simply clip the (white) lead off very close and disregard it.

CRT replacement

I have a Magnavox CT235A in the shop. I replaced the picture tube, a 12LP4, with a rebuilt. The neck of the new tube is much shorter than the original. There's very little play for the ion-trap, yoke and focus coil. I have a raster but no picture.—P. A., New York, N.Y.

One big possibility here, of course, is the rebuilt picture tube is bad! Anoth-

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3.58
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• The PS120 provides features never before offered. Only two major controls make the PS120 as easy to use as a voltmeter. Even its smart good looks were designed for functional efficiency. New forward thrust design, creating its own shadow mask, and full width calibrated graph increase sharpness of wave form patterns. A permanent chromed steel carrying handle instead of untidy leather strap and a concealed compartment under panel for leads, jacks and AC line cord make the PS120 the first truly portable scope combining neatness with top efficiency.

• Electrical specifications and operational ease will surpass your fondest expectations. Imagine a wide band scope that accurately reproduces any waveform from 20 cycles to 12 megacycles. And the PS120 is as sensitive as narrow band scopes . . all the way. Vertical amplifier sensitivity is .035 volts RMS. The PS120 has no narrow band positions which cause other scopes to register erroneous waveforms unexpectably. Another Sencore first is the Automatic Range Indication on Vertical Input Control which enables the direct reading of peak-to-peak voltages. Simply adjust to one inch height and read P-to-P volts present. Standby position on power switch, another first, adds hours of life to CRT and other tubes. A sensitive wide band oscilloscope like the PS120 has become an absolute necessity for trouble shooting Color TV and other modern circuits and no other scope is as fast or easy to use.

SPECIFICATIONS

WIDE FREQUENCY RESPONSE:

Vertical Amplifier—flat within ½ DB from 20 cycles to 5.5 MC, down —3 DB at 7.5 MC, usable up to 12 MC.

Horizontal Amplifier—flat within —3 DB from 45 cycles to 330 KC, flat within —6 DB from 20 cycles to 500 KC.

HIGH DEFLECTION SENSITIVITY:

		RMS	P/P
Vertical Amplifier—	Vert. input cable	.035V/IN.	0.1V/IN.
	Aux. vert. jack	.035V/IN.	0.1V/IN.
	Through Lo-Cap probe	.35V/IN.	1.0V/IN.
Horizontal Amplifier—		.51V/IN.	1.44V/IN.

HIGH INPUT RESISTANCE AND LOW CAPACITY:

Vert. input cable	2.7 Meg. shunted by approx. 99 MMF
Aux. vert. input jack	2.7 Meg. shunted by approx. 25 MMF
Through low cap. probe	27 Meg. shunted by 9 MMF
Horiz. input jack	330 K to 4 Meg.

HORIZONTAL SWEEP OSCILLATOR:

Frequency range—	4 ranges, 15 cycles—150 KC
Sync Range—	15 cycles to 8 MC-usable to 12 MC

MAXIMUM AC INPUT VOLTAGE:

Vertical input cable— Aux. vert. jack— Lo-Cap probe—	1000 VPP (in presence of 600 VDC)
Horiz. input jack—	approx. 15 VPP (in presence of 400 VDC)

POWER REQUIREMENTS:

Voltage—	105-125 volts, 50-60 cycle
Power consumption—	On pos. 82 watts Stby. pos. 10 watts

SIZE: 7″ wide x 9″ high x 11¼″ deep—weight 12 lbs.

The PS120 is a must for color TV servicing. For example, with its extended vertical amplifier frequency response, 3.58 MC signals can be seen individually.

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er is a possible wrong connection on the base. The original tube had a nonstandard base. Check out the connections to see that each goes to the proper element. Follow the signal through with a scope to see that you have video on the CRT grid.

The short neck could be due to the rebuilding process.

Color tuning

In an RCA CTC4 color TV, the hue adjustment binds now and then. The color works OK, but this adjustment is hitting something on the inside, or the shaft is binding.—J. F. K., Oklahoma City, Okla.

The hue adjustment on this set is a small metal blade which changes the inductance of the coil in the color-phase detector plate (Fig. 5). This coil and blade adjustment is mounted on the control panel as in Fig. 6. A slug inside the coil tunes it to the proper inductance. It is possible to set the slug to the wrong position inside the coil. If it's screwed too far back away from the panel, the end of the slug will sometimes come out of the coil form and hit the blade. The correct position for this is near the front of the coil. Turn it counterclockwise until you get the same setting.

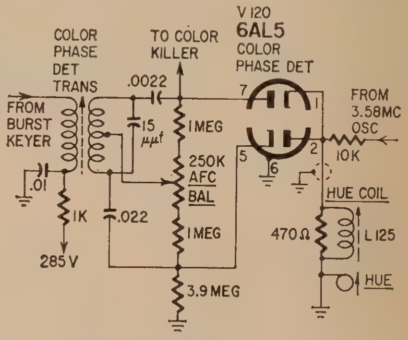

Fig. 5—RCA CTC4 hue control circuit. Small metal blade varies hue-coil inductance for control.

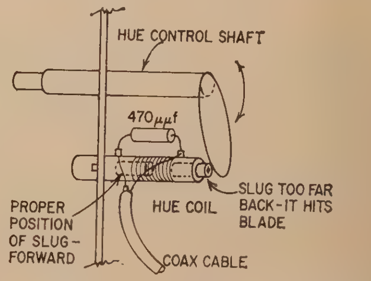
HUE CONTROL SHAFT
470μμf
PROPER POSITION OF SLUG-FORWARD
HUE COIL
SLUG TOO FAR BACK-IT HITS BLADE
COAX CABLE

Fig. 6—When hue-coil slug is too far back, it hits tuning blade. Readjust it so slug is toward front of coil.

Matching FM tuner input

The input impedance of my FM tuner is 240 ohms. I want to connect a 300-ohm outside antenna to this.—F. D., Camden, N. J.

Go ahead and hook it up. The tolerance here is usually wide enough to take care of small mismatches. I don't think you will find any difference.

If you want to be very particular about it, you can taper a piece of 300-ohm line. Slit the center web of the line, for about 24 inches, and bring it gradually closer together until it is about ⅜ inch apart instead of the normal ½ inch (Fig. 7). This will make an exact match for the 240-ohm input. However, I have tied 365-ohm open-wire TV line directly to 300-ohm ribbon without ill effects. The bandpass is so broad that any minor mismatch is more or less swamped out. However, if you're matching 72-ohm coax to 300-ohm input you will definitely need a matching transformer. They're inexpensive and work just fine. Install the transformer at the back of the TV set.

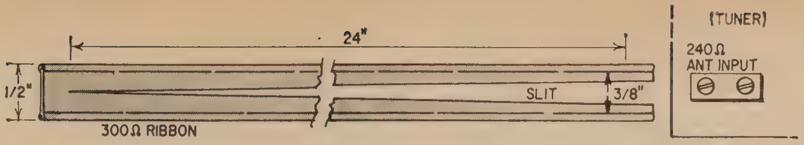

Fig. 7—300-ohm line may be split and tapered to make exact match to 240-ohm input.

B-plus supply trouble

I replaced the 5U4-GB rectifiers and the B-plus filter resistors in an RCA CTC5 color TV chassis. In a month it came back to the shop with the same trouble. Replacing the same parts cured it, and it plays fine. I'm afraid to return it again! It may be back with the same trouble once more!—W. R., Jamaica, N. Y.

This must be high line voltage trouble at the home, from the symptoms. Before I'd put the set back into service, I'd request a 24-hour line-voltage check from the power company. In similar cases, we have found surges as high as 150 volts at odd hours. You might install a line-voltage regulator or a Surgistor in the TV chassis just for luck. They are always excellent protection.

I would try cooking this set at the shop for at least 8-10 hours, preferably on about a 10-15% high line voltage, to be sure that there is nothing intermittently shorting elsewhere in the chassis.

Vertical bars

I have a Silvertone portable, model 7102S. When the picture is light gray, it shows a series of evenly spaced lines, similar to sound bars, but vertical. They are about ¾ inch wide. This is especially prominent during commercials. Voltages and capacitors seem to check OK.—E. J. B., W. Roxbury, Mass.

The most common cause of this type of trouble is ringing in the yoke or horizontal deflection circuits. In this set, it would be caused by failure of the 62-$\mu\mu f$ capacitor in series with a 1,000 resistor in the yoke housing. This is connected across the "top" half of the yoke (the part which connects directly to the flyback).

It can also be caused by horizontal radiation reaching the video circuits. You can check this by noting the appearance of the raster lines. If they bend at each of the bars and the lines decrease in intensity going from left to right across the screen, then the trouble is in the yoke. If the scanning lines are *straight*, but vary in *intensity*, the trouble is vertical signal leaking into the video. Dress the antenna-to-tuner lead as far away from all parts of the horizontal circuit as possible. Radiation from the yoke leads is a fairly common cause of this trouble, too. To cure this, wrap the yoke cable in metal foil (if you can find a piece of foil of the type with paper backing on one side, it is very handy). Cover the yoke leads as completely as possible, wrap the foil with fine bare wire and ground both ends (under a handy screw). END

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1L4
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1Q5GT
1R5
1S5
1T4
1U4
1U5
1V2
1X2
2A3
2AF4
3BC5
3BN6
3BZ6
3CB6
3CF6
3CS6
3LF4
3Q4
3S4
3V4
4BQ7A
4BZ7
5AS8
5AT8
5AV8
5AW4
5BK7
5J6
5T8
5U4G
5U8
5V4G
5V6GT
5X8
5Y3GT
5Y4G
6A7
6A8
6AB4
6AC7
6AF4
6AG5
6AG7
6AH4GT
6AH6
6AK5
6AL5
6AL7
6AM8
6AN8
6AQ5
6AQ6
6AQ7GT
6AR5
6AS5
6AT6
6AT8
6AU4GT
6AU5GT
6AU6
6AU8
6AV5GT
6AV6
6AW8
6AX4GT
6AX5GT
6B8
6BA6
6BC5
6BC8
6BD6
6BE6
6BF5
6BF6
6BG6G
6BH6
6BJ6
6BK5
6BK7
6BL7GT
6BN6
6BQ6GT
6BQ7
6BY5G
6BZ6
6BZ7
6C4
6C5
6C6
6CB6
6CD6G
6CF6
6CG7
6CL6
6CM6
6CM7
6CN7
6CS6
6CU6
6DE6
6DQ6
6F6
6H6
6J4
6J5
6J7
6K6GT
6K7
6K8
6L7
6N7
6Q7
6S4
6S8GT
6SA7
6SC7
6SF5
6SF7
6SJ7
6SK7
6SL7GT
6SN7GT
6SQ7
6SS7
6T4
6T8
6U8
6V6
6W4GT
6W6GT
6X4
6X5
6X8
6Y6G
7A4/XXL
7A5
7A6
7A7
7A8
7B4
7B5
7B6
7B7
7B8
7C4
7C5
7C6
7C7
7E6
7E7
7F7
7F8
7H7
7N7
7Q7
7X7/XXFM
7Y4
7Z4
12A6
12AQ5
12AT6
12AT7
12AU6
12AU7
12AV6
12AV7
12AX4GT
12AX7
12AZ7
12B4
12BA6
12BA7
12BE6
12BF6
12BH7
12BQ6
12BR7
12BY7
12CA5
12J5
12K7
12L6
12Q7
12SA7
12SG7
12SJ7
12SK7
12SN7GT
12SQ7
12V6GT
12W6GT
12X4
12Z3
14A7/12B7
14B6
14Q7
19
19AU4GT
19BG6G
19J6
19T8
24A
25AV5
25BQ6
25DN6
25L6GT
25W4GT
25Z5
25Z6
26
35A5
35B5
35C5
35L6GT
35W4
35Y4
35Z5GT
37
39/44
42
43
45
50A5
50B5
50C5
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50X6
56
57
58
71A
75
76
77
78
80
84/6Z4
117Z3
117Z6

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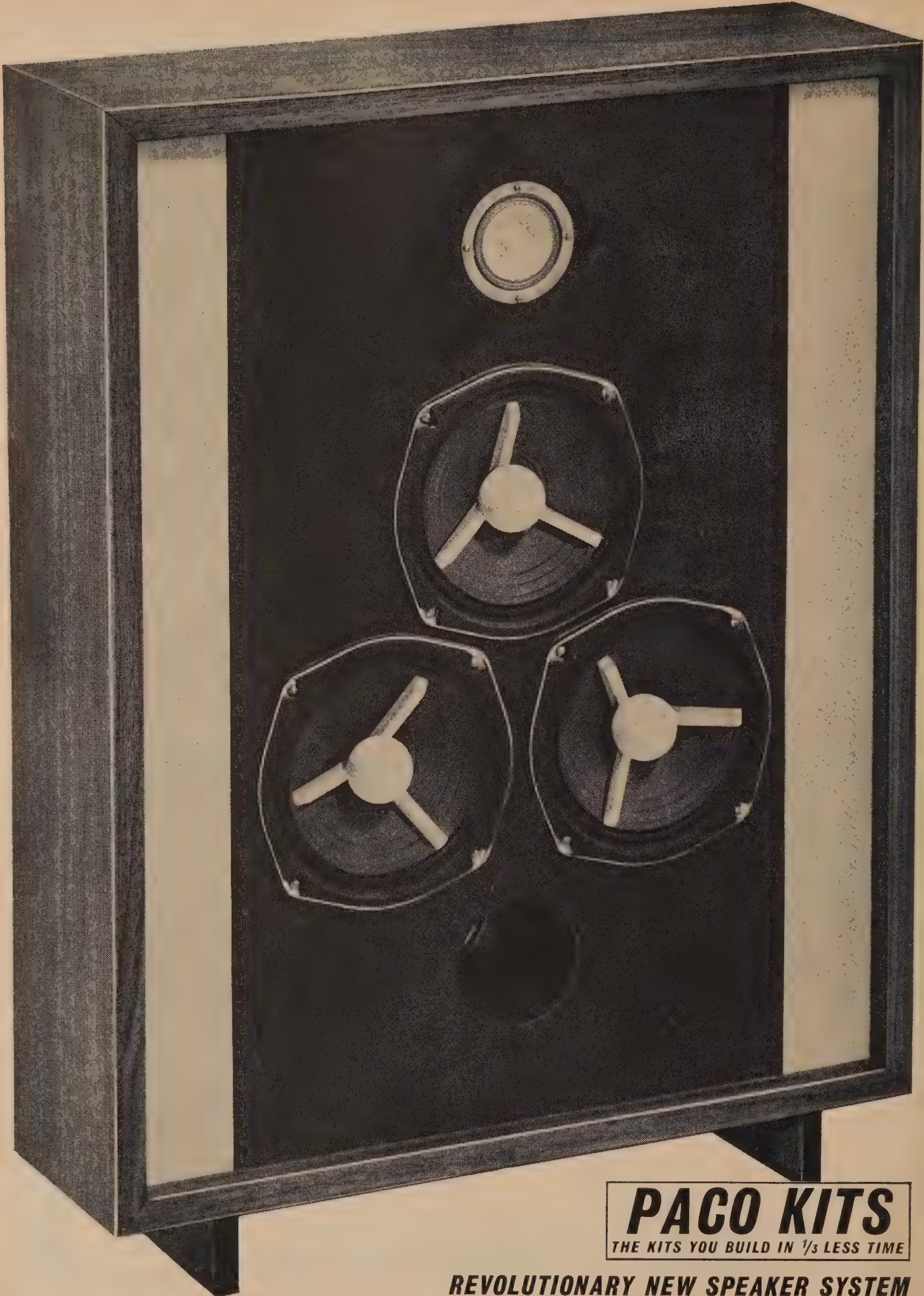

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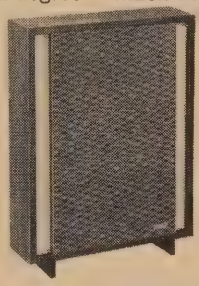

Model L4 by PACO: $99.95 net.

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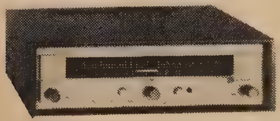
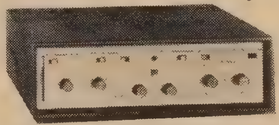
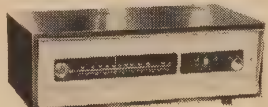


ST-55MX FM Stereo Multiplex Tuner Kit (Prealigned; less enclosure): $99.95 net. Factory wired (includes enclosure): $159.95 net. Enclosure: $7.95 net.



ST-50 Stereo Preamp-Amplifier Kit (less enclosure): $79.95 net. Factory wired (includes enclosure): $149.95 net. Enclosure: $7.95 net.



ST-25MX FM Stereo Multiplex Tuner Kit (Pre-aligned, less enclosure): $69.95 net. Factory wired: $99.95 net. Enclosure: $14.95 net. (walnut); $4.95 net. (metal).

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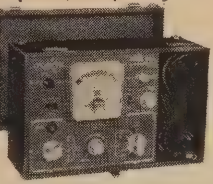

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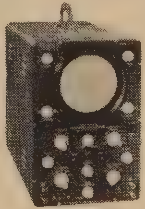

Model S-55 Wide-Band Oscilloscope. Covers range between DC and 5 mc. Kit: $95.95 net. Factory wired: $155.95 net.

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Uhf in every television set

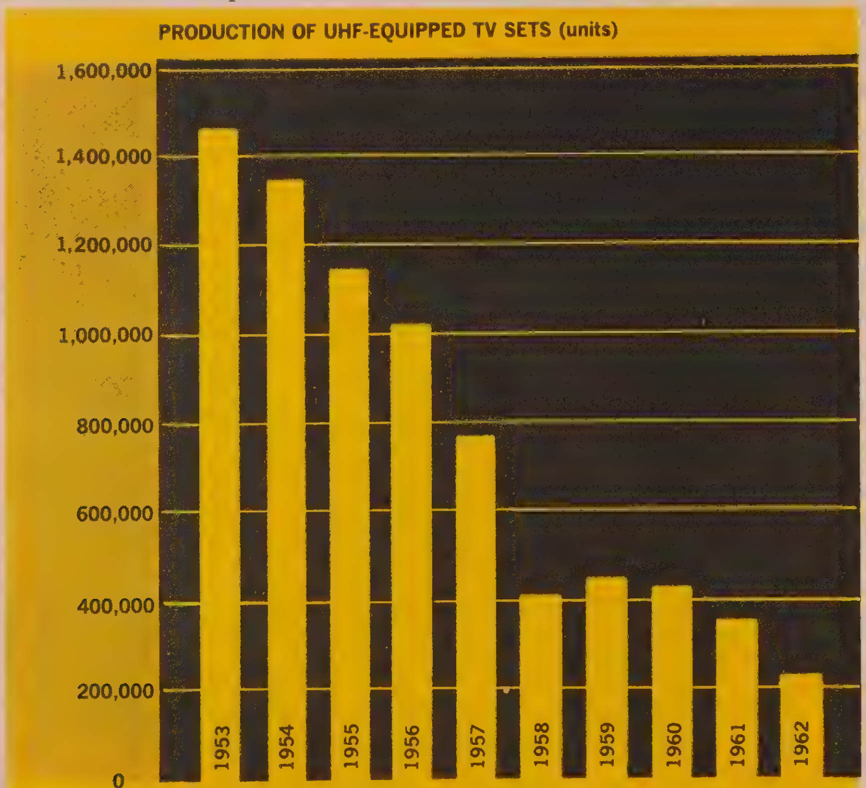
By **DAVID LACHENBRUCH**

What the all-channel law means to you

THE ALL-CHANNEL SET LAW PASSED RE-cently by Congress requires that all TV's must include a uhf tuner. This is an all-out attack on the problem which has beset uhf TV broadcasting for its 10 years of existence—lack of receivers that can pick up uhf broadcasts. All other attempts to deal with this problem have failed.

Under present allocations, the 12 vhf channels can provide only about 630 television channels in the continental United States, and the vast majority of these are now in operation. Full use of uhf's 70 channels would provide more than 1,500 additional stations. If there is to be further growth for TV under the present channel-allocation system, it can be only in the uhf band.

Expansion problems are particularly acute in the growing field of educational TV. Of 275 channel allocations presently assigned for education, 227 are in the uhf band. In commercial television the development of additional program choices and opportunities for local expression depend upon full use of uhf.



1952 was first year of uhf production; figures unavailable. Source: EIA

These figures are sets equipped for all-channel tuning at the factory. They do not include field conversions (which outnumbered factory-equipped sales 1.5 to 1 in 1953–55, then dropped sharply). Nor do they include uhf strips.

Uhf's problems became apparent shortly after the FCC authorized telecasting in this band in 1952. The immediate troubles seemed to stem from the shorter range of uhf stations and the difficulty of picking up their signals. But the real problem was receiver conversion.

Very early in the game, it became apparent that viewers would readily convert their vhf sets or buy uhf receivers in areas where vhf reception was inadequate. In regions where uhf stations had little or no competition from vhf, there was no difficulty in approaching 100% uhf conversion, despite the so-called "technical problems" of uhf. Uhf stations in these areas have prospered.

But in localities where uhf was forced to rub elbows with vhf in direct competition, the public stubbornly refused to convert or to buy all-channel sets. Their needs were perfectly satisfied by the existing vhf sets—why spend more money or fuss around with tricky antennas?

The early uhf boom of 1952–53 soon turned to gloom. Nearly 100 uhf stations quickly found they couldn't cope with vhf competition and went off the air. A far larger number of authorized uhf stations were abandoned without ever having been built. Uhf receiver production dropped from 1,459,475 sets in 1953 to 370,977 in 1961. Today there are about 100 uhf stations still on the air, mostly in areas where they don't have to compete directly with a number of vhf outlets, although a few nonprofit educational uhf stations are serving small numbers of viewers in predominantly vhf areas.

The first remedy proposed for uhf's troubles was "de-intermixture." This was a proposed re-allocation program to eliminate direct competition between vhf and uhf stations. It would have made some areas all-vhf and others all-uhf, requiring some existing vhf stations to change to uhf. Vhf broadcasters objected, and argued that de-intermixture would leave large rural areas without any television because of uhf's limited coverage range.

Under mounting pressure from Congress to do something about the uhf problem, FCC acted on two fronts:

1. It decided to get first-hand experience in technical problems and established its own super-power uhf station, WUHF, on channel 31 in New York City. New York was selected because its tall buildings make it uhf's most challenging location. This experiment is still under way, but preliminary results appear to indicate that uhf can serve New York, although not as satisfactorily as vhf.

2. It mapped an attack on uhf's

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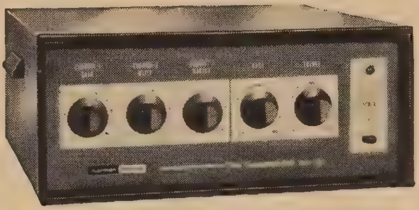

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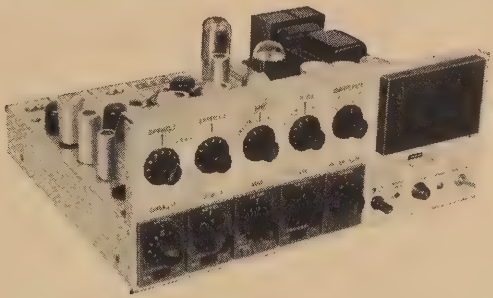

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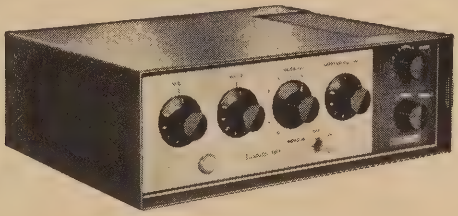

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problems from the receiving as well as the transmitting end, and proposed a bill to ban interstate shipment or import of receivers without all-channel tuners. The FCC reasoned that within a span of about 10 or 12 years after the law became effective, almost all sets in use would be able to receive both vhf and uhf channels, eliminating one of uhf's biggest handicaps—lack of sets.

In return for a promise to drop its de-intermixture proposals, most vhf broadcasters backed the FCC's proposal for this unprecedented legislation to regulate the television set manufacturing industry. The bill was opposed by the Electronic Industries Association and most television set manufacturers who had no broadcast station interests.

As finally passed by Congress and signed by the President in July, the law authorizes FCC to require that all sets be "capable of adequately receiving" all TV channels. That word which so neatly splits the infinitive—"adequately"—is the key word in the law.

The next moves are now up to the FCC, which is already holding conferences with industry representatives on how to implement the law. First, it must define the word "adequately." In effect, the definition will set some sort of minimum standard for the performance of the required uhf tuners. The commission is expected to interpret the law as requiring tuners which can receive the entire uhf band, rather than a few selected channels.

The commission must also establish a cutoff date—"U-Day"—after which all sets shipped must include uhf tuners. This must be far enough in the future to allow receiver and tuner manufacturers to gear up for increased production of uhf tuners—from an annual rate of about 370,000 to around 6,000,000. It must also give manufacturers time to clear their inventories of already-built vhf-only sets.

Although the cutoff date hadn't been set at press time, most informed industry and FCC guessers were estimating it would probably be between 1 and 2 years from the time of passage of the law—which would place it between July 1963 and July 1964.

But manufacturers aren't inclined to drag their heels. They've already begun planning for U-Day. Even though it vigorously opposed the law, their spokesman, EIA, has pledged full cooperation. Industry representatives had even begun preliminary conferences with FCC engineers before President Kennedy signed the bill into law. Most manufacturers are anxious to cooperate—although there's always a possibility that someone might delay or bar application of the law by challenging its constitutionality in the courts.

Even while Congress was still debating the bill, the effects of all the "uhf talk"—and the widespread opinion that the bill would pass—seemed to be starting something of a boomlet in uhf. Production of all-channel sets in the first 4 months of 1962 totaled 185,750, more than double the 90,400 produced during the comparable period of 1961. The FCC began to receive a few applications for uhf channels again, after a long famine.

Already the results of set makers' preparations for U-Day are beginning to appear. In the new models introduced this summer for fall selling, a greater number of sets are available in vhf–uhf versions or can be converted internally to all-channel performance. Here's the probable timetable for the future:

With the introduction of the so-called 1964 TV lines next summer, virtually every model will be designed for easy internal conversion to uhf by continuous tuner kits, which will be readily available. Nearly all switch and turret tuner dials will be marked for uhf.

Meanwhile, tuner manufacturers have already instituted their own crash programs for more compact and better uhf tuners, and are preparing for vastly stepped-up output. The new continuous tuners will represent improvements on existing ones rather than engineering innovations, and they'll be ready in time for sets introduced next year.

Antenna makers, too, are gearing for increased demand for outdoor uhf installations. But they expect the rise to be more gentle, occurring gradually as prospective uhf telecasters take heart as a result of the more favorable climate for uhf stations.

Most standard sets offered next year will still be of the vhf-only variety. But distributors and dealers will be well stocked with uhf tuner kits for in-the-store and field conversion, while factories continue to ship complete all-channel sets mainly to uhf areas.

As U-Day approaches, set makers will make a relatively simple change-over. Instead of shipping sets that can be converted in the field, they will convert all sets in their inventory—so that no manufacturer will be stuck with unshippable vhf-only sets. All future sets will then be built with continuous uhf tuners in them from the start.

Of the nation's 56,000,000 sets, only an insignificant percentage are now equipped to receive all channels. An important start has been made on a long-range plan to utilize a vast national resource—the uhf TV band. If the all-channel law succeeds in its purpose, this new expansion will directly affect every viewer by increasing his choice of TV programs and services. For those who make their livelihood in television, it could mean a new boom second only to television's original growth. END

What's Your EQ?

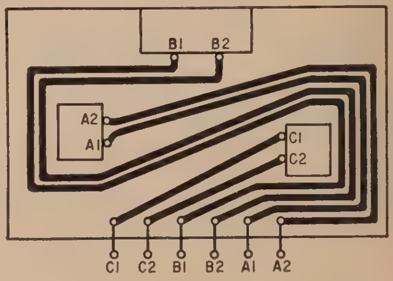
Answers to puzzles on page 47

A Capacitance Problem

The resistance sees the series combination of the 20-μf and the 5-μf capacitor—in other words, 4 μf. The time constant is therefore 4 μf times 0.5 megohm, or 2 seconds. In 10 seconds, the voltage across the resistance—between points A and B—is practically zero. But how about the voltages across the individual capacitors? A 4-μf capacitance, charged to 400 volts, holds a charge of 1,600 microcoulombs. This is the charge that has flowed through the resistor during the discharge process. But the 20-μf capacitance held a charge of $200 \times 20 = 4{,}000$ microcoulombs at the beginning. After 1,600 have been taken out, it still holds 2,500. The voltage across its terminals is therefore 120, with the same polarity as at the start. The 5-μf capacitor originally held $5 \times 200 = 1{,}000$ microcoulombs; if 1,600 were displaced during the discharge, it first discharged to zero and then charged to the opposite polarity with 600 microcoulombs. This makes the voltage across it also 120, but with a polarity opposite to the original.

A Tracking Problem?

This puzzle was proposed (and solved) back in the days of Sam Lloyd, long before printed circuitry—or even radio—was though of. The solution:



Distribution Problem

$E_1 = R_1 (I_1 + I_2)$
$= 26 (0.8 + I_2)$
$= 20.8 + 26I_2$
$E_2 = 40I_2$
$E_1 + E_2 = 100$
$20.8 + 26I_2 + 40I_2 = 100$
$20.8 + 66I_2 = 100$
$66I_2 = 79.2$
$I_2 = 1.2$ amps

From here on the problem is easy, and can be solved with Ohm's law:

$E = 100$ volts
$E_1 = 52$ volts
$E_2 + E_3 = 48$ volts
$I_1 = 0.8$ amps
$I_2 = 1.2$ amps
$R_1 = 26$ ohms
$R_2 = 60$ ohms
$R_3 = 40$ ohms

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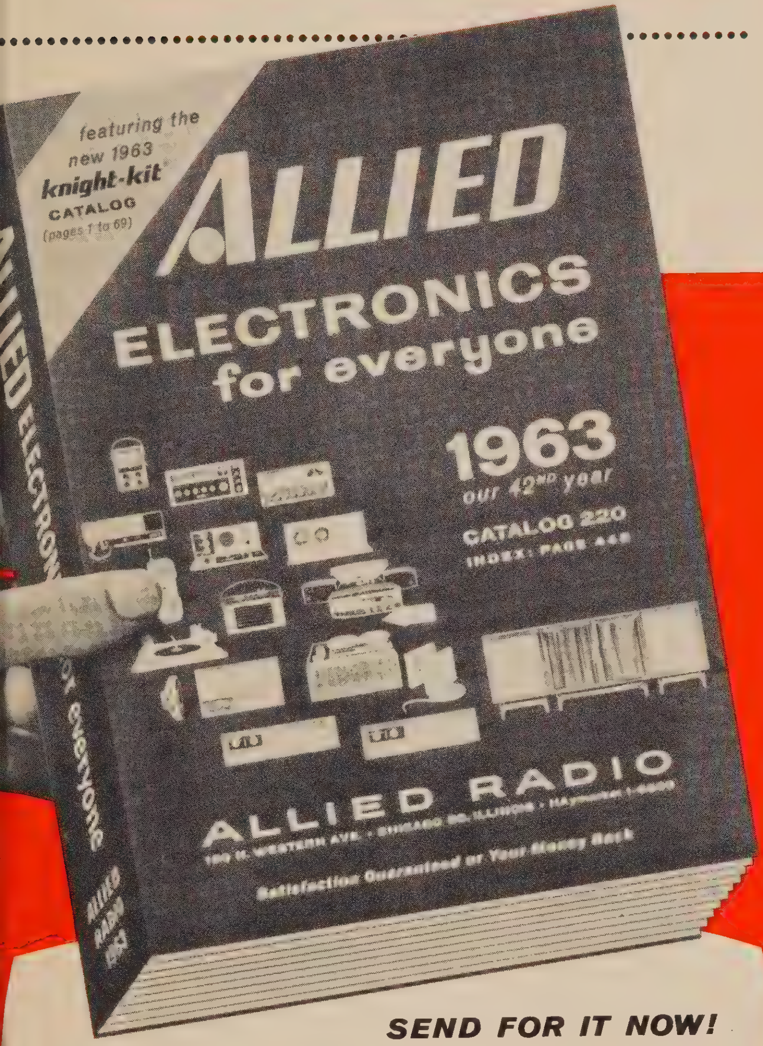
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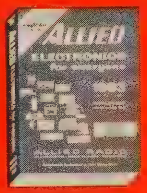

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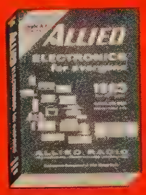

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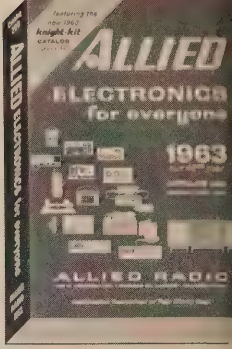

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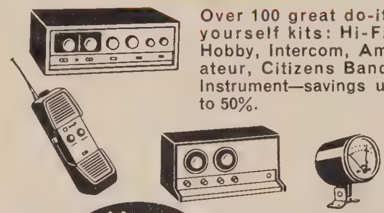

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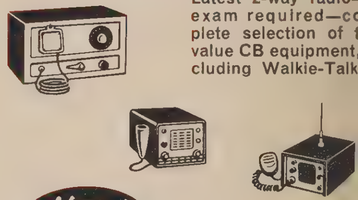

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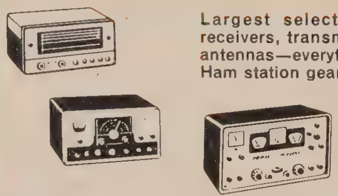

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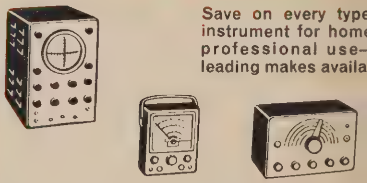

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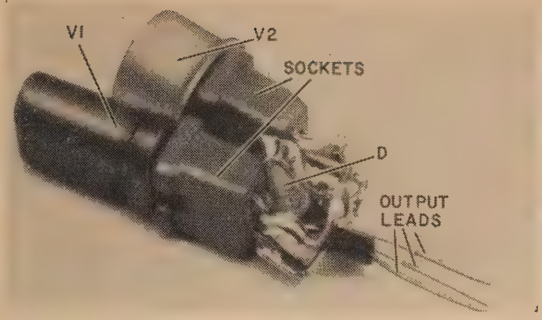

BUILD THIS... COMPOSITE TRANSISTOR

You'll end up with a unit that has a gain of about 2,000 in a 4-volt circuit

By **ELLIOTT A. McCREADY**

LOUIS GARNER'S ARTICLE ON THE COMposite Transistor in the June 1961 issue of RADIO-ELECTRONICS made fascinating reading. Most of us who have worked with transistors know that a series of direct-coupled transistors would be the simplest and cheapest way to build an amplifier. No interstage transformers, capacitors or resistors!

The further knowledge that leakage current in input and subsequent stages would be amplified right along with the signal was, at least in my case, reason enough to discourage any attempt at building such an amplifier.

After reading Garner's article, I wasn't so sure that such a project wouldn't be feasible—some transistors have remarkably low collector-to-emitter leakage. The composite transistor described here is only a two-stage unit but boasts a beta, or current gain, of around 2,000 at 4 volts. Leakage current is in the neighborhood of 200 μa, which isn't at all unreasonable. If you have access to a good supply of transistors, you can probably better these figures somewhat.

Parts selection

The home-built composite transistor is limited to two stages for several reasons. First, even with the most carefully chosen commercial transistors, leakage current in a three-stage composite would be intolerable. In my unit, the addition of a third stage with even a most modest beta of 20 would increase leakage current from 200 μa to around 4 ma. A third stage would also call for a power transistor output complete with heat sink and physical isolation from the first stages.

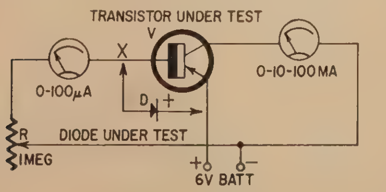

Fig. 1—Leakage current and beta test setup.

To make this project successful all components must be hand-picked. The input transistor must be carefully chosen for minimum leakage current—beta isn't too critical here. The output stage must have high beta together with a reasonably low leakage current. I have found that rf transistors tend to have lower leakage current than those designed for audio work. The transistors in my composite are a CK-768 input and a CK-913 output. Both are Raytheon's and are moderately priced. They are, however, old types no longer manufactured, and may not be available. If you can't get them, use a 2N416 for the CK-913 and a 2N413 for the CK-768.

If you have access to a transistor tester that will measure both beta and leakage current, selecting the best transistors is simple. If not, take a look at Fig. 1: It shows a leakage-current and beta test setup. Leakage current is measured with the transistor base disconnected at point X. Beta is determined by first connecting the transistor base to its bias supply through pot R and observing the increase in collector current produced by a given increase in base current. Dividing the *increase* in collector current by the *increase* in base current will give beta, or current gain. For instance, if an increase in base current of 10 μa (say, from 20 to 30 μa) causes a 1-ma increase in collector current (say an increase of from 2 to 3 ma), the beta of the transistor would be:

$$\frac{.003 - .002}{.00003 - .00002} = 100$$

When measuring beta, keep base current low and changes in base current small to avoid changes in collector-to-emitter voltage, which would render the results of the test inaccurate.

Start by selecting the output transistor. Choose one with a reasonably high beta—upward of 100—and fairly low leakage current. The CK-913 I used showed a beta of 150 and a leakage current of about 40 μa.

Next, select a diode. Then connect the transistor you chose for the collector-emitter leakage test of Fig. 1. Now connect the diode as shown between the transistor base and emitter and note the decrease in leakage current. Try several diodes and select the one which brings transistor leakage current to its lowest value.

The input transistor is chosen mainly for low leakage current. Remember, 10-μa leakage in the input transistor will result in a composite leakage of around 1 ma, assuming the output transistor has a beta of 100. The CK-768 I used showed a leakage of around 3 μa.

Construction

I used two miniature hearing-aid sockets in the construction of my composite transistor (Fig. 2). However, the unit may be made considerably smaller if sockets are not used. If you decide to dispense with the sockets, be *extremely careful* when soldering the transistor and diode leads. Use long-nose pliers as a heat sink between the joint and the body of the transistor, and a *small, hot iron* for a minimum period of time to complete the connection.

Too much heat at this point may permanently change the characteristics

(Continued on page 74)

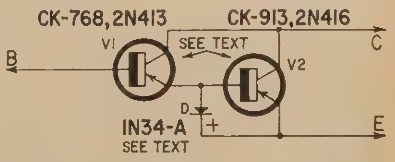

Fig. 2—Circuit of composite transistor.

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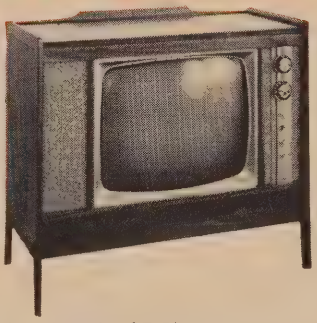

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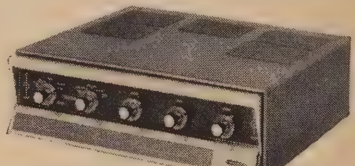

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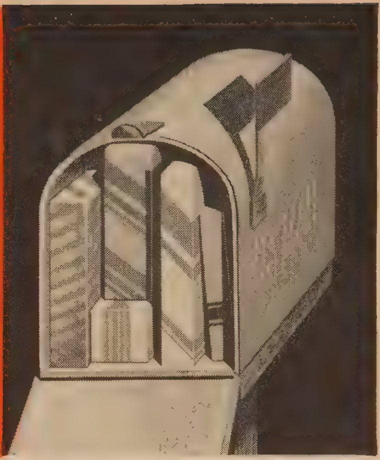

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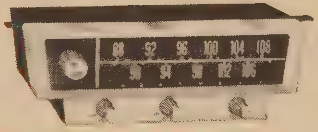

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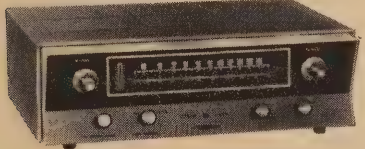

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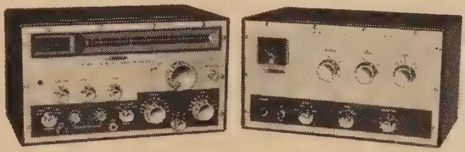

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ITEM	MODEL NO.	PRICE

The unit is potted after thorough testing.

(Continued from page 71)

of one of your carefully chosen transistors. Leave long leads from the collector and emitter of V2 and the base of V1 if you don't use sockets. If you build the unit around two sockets, solder the excess leads clipped from a transistor in place as output terminals.

Testing the unit

After the composite transistor is completed, use the setup of Fig. 1 to test it. First, check leakage current—it should be in the neighborhood of 500 μa at 6 volts. Reducing the collector voltage reduces leakage current. At 1.5 volts, leakage should be around 100 μa, the lower the better.

Before testing for beta, replace pot R with a 3-megohm unit and *be sure it is set at maximum resistance!* Now connect the base of the composite and perform the beta test. **CAUTION: Advance R very slowly and limit collector current to not more than 25 ma at 6 volts or 100 ma at 1.5 volts. A limiting resistor in the base circuit might be advisable for this test. Use 270,000 ohms.**

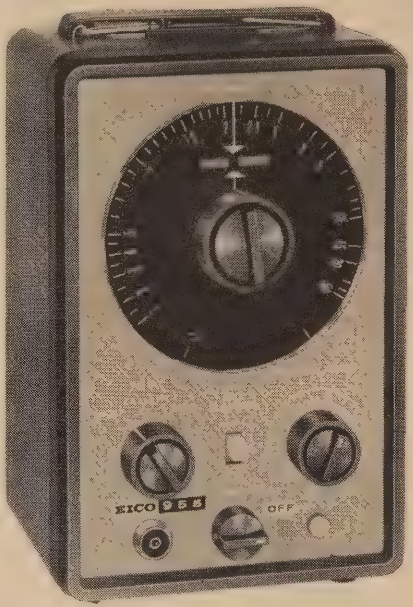
When tests are completed and the unit is operating satisfactorily, encapsulate it in anti-corona lacquer or a high-dielectric liquid plastic. If the liquid you use is opaque, be sure the output leads are properly identified.

Characteristics

The composite transistor has the characteristics of, and may be used as, a single high-gain transistor. Although the unit is necessarily much more temperature-conscious than an ordinary transistor, I have found no tendency toward thermal runaway. Leakage current increases slowly with temperature but rapidly returns to normal when temperature is decreased.

Although maximum power dissipation of the composite should be somewhat greater than that of the output transistor, I use this value (150 mw for the CK-913) as maximum. In applications requiring low leakage current, collector voltage may be reduced below the recommended maximum of 6 volts.

Altogether this little composite transistor is a very stable item, and any shortcomings are nicely compensated for by its extremely high gain. END


EICO 955
OFF

in-circuit capacitor checker...

saves time and effort—you don't have to lift one end of the capacitor before you check it

By LARRY STECKLER
ASSOCIATE EDITOR

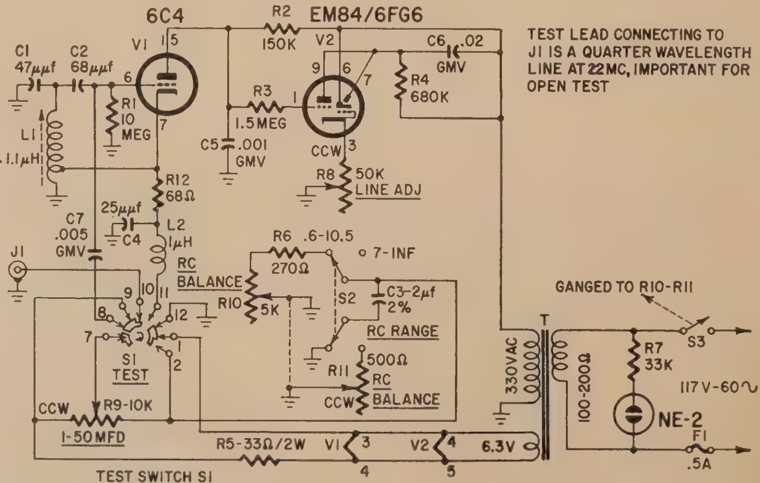
ONE THING ABOUT THE GARDEN-VARIETY capacitor tester never fails to get me—to check a capacitor in a circuit you must disconnect one end of it first. In a wired circuit, this can be tough enough. On some printed-circuit boards it's even tougher—especially if you don't particularly care for the printed boards. But there is a way around this problem—use an in-circuit capacitance checker.

Almost all new units fit in this category. Of course, they don't only check capacitors in circuit, they'll also do an excellent job on those bypasses you salvaged from an old radio. One of the newest in-circuit testers is the EICO model 955 (Fig. 1). It comes in a neat professional-looking case, but more important, does a neat professional job on most capacitors between 0.1 and 50 μf.

Certain capacitors cannot be checked with this instrument. If they are, they will be damaged. The limits call for no testing of capacitors rated below 6 volts dc and no prolonged testing of capacitors rated between 6 and 9 volts dc. Also, no polarized tantalum capacitors, no matter how high their voltage rating, should be tested.

Short test

The unit performs several tests and we'll take them one at a time. First we test for shorts, about the most common


6C4
V1
1 5
C1
47μμf
C2
68μμf
6
R1
10
MEG
7
L1
.1.1μH
R12
68Ω
25μμf
C4
C7
.005
GMV
L2
1μH
J1
9
10
11
8
12
7
1
2
S1
TEST
CCW
R9-10K
1-50 MFD
R2
150K
EM84/6FG6
V2
9
6
7
R3
1.5 MEG
1
C5
.001
GMV
CCW
3
R8
50K
LINE ADJ
R4
680K
C6
.02
GMV
TEST LEAD CONNECTING TO J1 IS A QUARTER WAVELENGTH LINE AT 22MC, IMPORTANT FOR OPEN TEST
R6 .6-10.5
270Ω
7-INF
RC
BALANCE
R10
5K
S2
C3-2μf
2%
RC RANGE
R11
500Ω
RC
BALANCE
CCW
R5-33Ω/2W
V1
3
4
V2
4
5
6.3V
330VAC
T
100-200Ω
GANGED TO R10-R11
S3
R7
33K
117V-60∿
NE-2
F1
.5A

TEST SWITCH S1

POS	SHORT	CAPACITANCE	OPEN
WIPER	1-12,8-9-10	1-2,7-8,9-10	10-11

Fig. 1—Circuit of the EICO 955.

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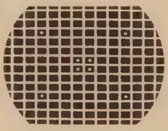
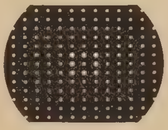
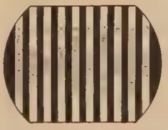


Enables you to troubleshoot and signal trace color circuits in color TV sets, or facilitate installation.



Generates white dot, crosshatch and color bar patterns on the TV screen for color TV convergence adjustments.



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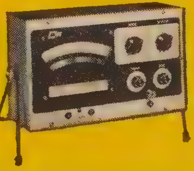
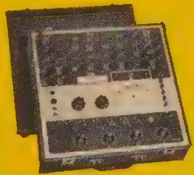


Model 375 Dynamatic Automatic VTVM



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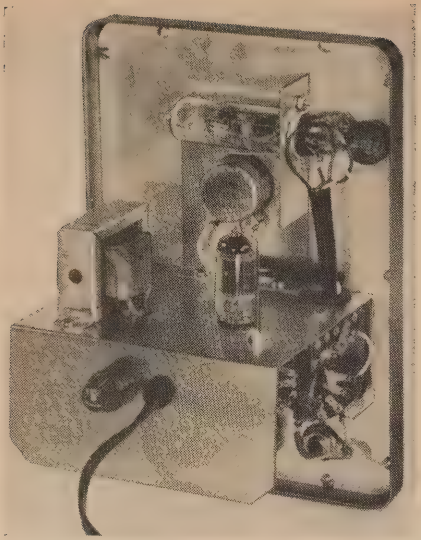

The in-circuit capacitance checker with its case removed.

of all capacitor faults. Even a 100-volt electrolytic that has always been used in a 10-volt circuit will short, and more often than you might think. Fig. 2 shows the circuit for the short test.

T's secondary delivers about 330 volts ac to V1's plate through R2. At the same time, 6.3 volts ac, of opposite phase, is applied to V1's grid through R5 and C7. It is also applied across the capacitor under test. If the capacitor is not shorted, it presents more than 1 ohm impedance to the applied voltage. The voltage reaching V1's grid is enough to keep plate current low. This in turn keeps the voltage drop across R2 low and makes V2's grid slightly positive with respect to V2's cathode. Obviously this causes high plate current for V2, a large voltage drop across R4, and a large voltage difference between the target and control electrode of the indicator tube. The result is that, when the capacitor is good, this difference of voltage at the indicator tubes keeps the bars of the indicator wide open, clearly showing that the capacitor is not shorted.

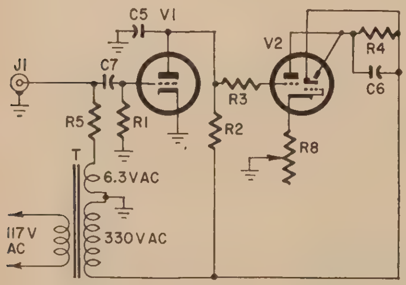

Fig. 2—Short-test circuit.

If we were testing a shorted unit, V1's grid and cathode would both have the same voltage, as they would be effectively tied together. When this happens, plate current in V1 increases and the drop across R2 also increases. This makes V2's grid more negative than its cathode, and plate current in this tube decreases. As a result, the voltage drop across R4 decreases and the voltage difference between the target and control electrode of the indicator tube also drops. End result—the indicator tube closes when the capacitor is bad.

Opens

If the unit wasn't shorted, we check for an open capacitor, the next most common capacitor fault. This time the circuit is arranged as in Fig. 3. V1 is now arranged as a Hartley oscillator. When it oscillates, plate current is low and the indicator bars stay open. If V1 does not oscillate, plate current increases and, as in the SHORT test, the bars close.

For the circuit to oscillate there must be a definite impedance across J1. If there isn't, the test cable together with L2, R12 and C4, which represents a quarter-wavelength line for the oscillator frequency, looks like a short at the input. This keeps V1 from oscillating, and the indicator bars close, revealing an open capacitor.

Check capacitance

If a capacitor proves to be neither shorted nor open, the only possible faults remaining are that it has changed in value or is leaky. A change is easy to check. All we have to do is measure its capacitance. For this purpose we use the circuit shown in Fig. 4. It works with the capacitor in or out of circuit. Here is where the EICO 995 does its best work.

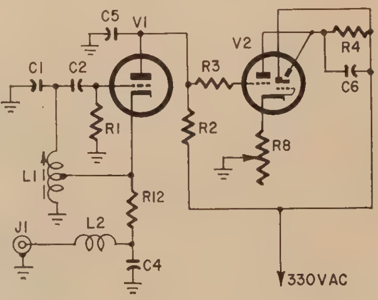

Fig. 3—Open-test circuit.

What we have here is a series and parallel capacitance bridge, an amplifier (V1) and an indicator (V2). When the bridge is balanced, no voltage comes from the bridge and V1's grid is at the same potential as its cathode. As before, this causes high plate current and the indicator-tube bars close. When the bridge is not balanced, a negative voltage is developed on V1's grid, reducing plate current and causing the indicator bars to open. The balancing resistor (R10 or R11, depending on capacitance range) has a calibrated dial and the value of the capacitor under test is read off this dial when the indicator bars are closed.

There is one interesting thing to note about the bridge. The shunt-resistance balancing pot is in series with the capacitor only for high R-C values. To measure low R-C, the pot is connected in parallel with the standard capacitor. This permits measuring capacitors that are shunted with small-value resistors and still getting a reasonably accurate reading. If you haven't already guessed, this pot balances out any shunt resistance across the capacitor.

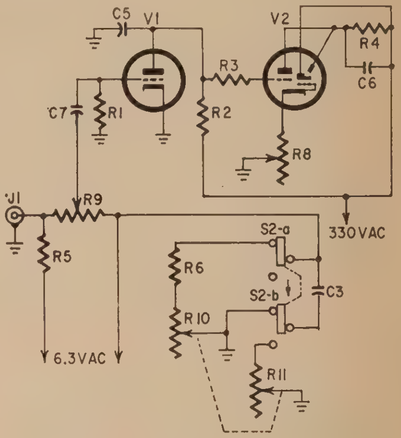

Fig. 4—Capacitance-test circuit.

To figure the R-C product, multiply expected capacitance value in microfarads by the expected resistance value in kilohoms. This will tell you which R-C range to use. If you don't know the values needed to figure the R-C product, set the R-C RANGE switch to the 7–INF position and the R-C BALANCE control to INF.

When testing for capacitance in circuit, rotate the capacitance dial until the indicator-tube bars are as close together as you can get them, then rotate the R-C BALANCE control to make the gap even smaller. Then it's back to the capacitance dial again. Continue this procedure until the bars close completely, then read on the dial the capacitance of the unit under test.

Points to ponder

As good as the instrument is, it has some limitations. Capacitors with a parallel resistance of less than 35 ohms may give a false reading during an in-circuit test. You will have to lift one end of these units to get an accurate reading. If two capacitors are connected in parallel, your in-circuit test reading will show their total capacitance and will not indicate the value of each unit individually. And, as a last condition, you cannot measure any capacitors that fall above or below the 0.1–50-μf range, nor R-C combinations that have an R-C product measured in μf and kilohms of less than 1. END

CB for Marine Safety

By BOB BARRY*

"WIRELESS" COMMUNICATION FIRST CAME into general use as an item of safety of life at sea. Over the years the brass-pounder has saved many lives with his dots and dashes. With the growth of small boating in the US during the past two decades, the radio-telephone has kept up the lifesaving tradition.

Now that boating is no longer a luxury item but a mass operation, radio is still too expensive an item for many.

A radiotelephone operating in the 2–3-mc band assigned for safety use is still a high-priced project for the small boat owner. Also the dependability of such communication leaves much to be desired. Within a hundred miles of New York, for example, several thousand boats are sailed during a summer weekend. They have only two channels, 2638 and 2738 kc, on which to exchange "business" communication. By international agreement 2182 kc is set aside as a "calling and distress" band.

These frequencies are used by steamships, tugs, workboats, fishing boats and pleasure craft. They are a bedlam of noises and sounds. Courtesy is unknown, and violations of the law are heard every few minutes. A 150-watt ether-buster on a steel-hulled boat will hash up communication between two smaller sets a hundred miles away. The 2182 "distress" channel is used for routine conversations and fishing chatter, without apparent fear of FCC reprisal or regard for possible actual distress.

The many US Coast Guard lifeboat stations maintain a watch on 2182 but many times we've heard two and even three Coast Guard stations, all with a boat in trouble offshore, trying to contact their own local problem boat and all interfering with each other.

In this same area there are only four channels for ship–shore telephone conversations.

On a summer afternoon with thunderstorms playing about, the static adds to the normal din, making the use of the 2-mc band rough even for the 150-watters and a complete failure for the 18-watters. Meanwhile, back on the Citizens-band channels, communication is dependable and static is at a minimum.

During the past year a number of pleasure boats have installed Citizens-band equipment. The results have been encouraging as far as ship-to-ship and ship-to-shore traffic is concerned. CB units carry well over salt water, much better than over land. Still pretty much of a line-of-sight proposition, they suffer much less interference.

But—and it's a big BUT—for "safety of life at sea" CB sets are useless. They are the absolute answer for general communication needs of the boatman, but, if he gets into trouble, he can't call for help.

Our suggestion for making safety at sea a reality and bringing the cost of such safety within reach of the small boatmen: Let the FCC set aside a frequency adjacent to the Citizens band, such as 26.950, to be used as a DISTRESS ONLY channel. Its use would be limited to messages coming under the MAYDAY, PAN, and SECURITE definitions. The Coast Guard would equip its installation for this frequency and, by so doing, would have a more efficient system for handling emergency traffic. Protection would be extended to many thousands of craft on salt water, inland lakes, and rivers. The current safety communications system is completely inadequate on 2182 kc. But 26.950 mc would offer *real* protection for the waterborne millions at a price they can afford.

[Bob Barry is a boatman and radio operator, having held a commercial ticket since 1931. He writes a boating column for a picture magazine, and recently worked with a marine radio concern, promoting CB radio among his other activities.—*Editor*]

---

*Formerly communications officer, 3rd Coast Guard District, U.S. Coast Guard Auxiliary.

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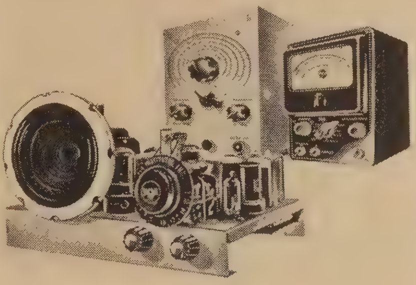

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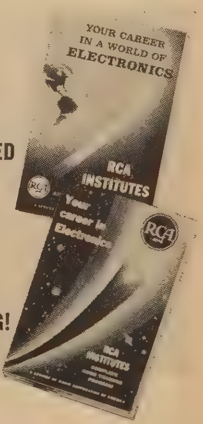
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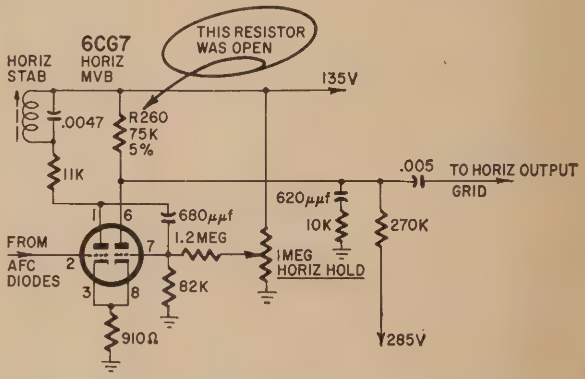
Technotes

RCA 21-CS-7815

Picture was very dark with only highlights of video information visible on some channels. Adjusting brightness and contrast controls had no effect. When the antenna was disconnected and the antenna terminals touched with a finger, channels 2, 4 and 5 came in pretty well, with fair color on channel 4 (set located in good signal area), brightness and contrast controls functioning. This immediately put the agc section under suspicion. The 6U8 agc amplifier and first sync. amplifier were replaced, and the set resumed normal operation.—*Michael L. Tortariello*

Hotpoint 14S202

This set had a rather unusual trouble. With no signal applied (antenna disconnected), the raster was perfect. But as soon as the antenna was hooked up, the raster would disappear.



A check through the horizontal oscillator stage revealed that resistor R260 was open. Just why it caused this particular trouble I still do not know but, when it was replaced with a new unit, normal operation was restored.—*William Porter*

CRT Heater Repair

When a CRT heater fails, the trouble is often within the base connections, rather than inside the envelope. The heavy current carried by the heater tends to oxidize the solder resulting in an open or high-resistance circuit.

We have repaired these for years with our own technique. Since we have never had a recurrence despite many more years of service, we consider the method completely satisfactory.

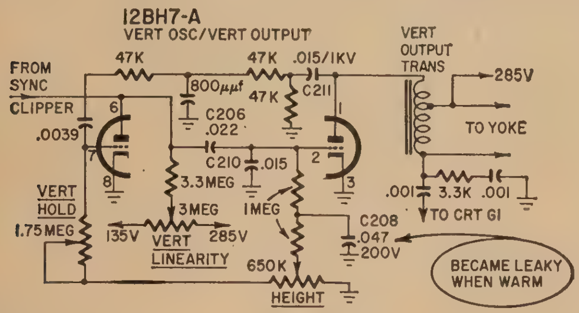
With a small triangular file, cut notches in pins 1 and 12, as close as possible to the base. Keep filing until the conductor running through the hollow pin is plainly exposed. Now apply heat until solder runs freely and fills the notch smoothly.—*H. R. Holtz*

G-E 14T017

After the set was on for a few minutes, the picture would roll and every 10 minutes or so the vertical hold would need readjustment. Changing the 12BH7 vertical tube did not help.

After removing the chassis, unscrew the printed board and swing it to the side to expose the circuitry. The symptoms pointed to thermal trouble so each part was heated while being tested. (Touching a soldering tip to the leads of a capacitor or resistor will cause it to react within a few seconds as it would after a half hour or so of cooking in a set.)

Applying 600 volts with my capacitor tester, the couping and wave-shaping capacitors C206 and C210 were checked first and found to be good. Next suspect was the .015-μf 1-kv feedback capacitor (C211), which also tested OK. The test voltage was dropped to 200 to check C208 and it seemed to be good until heat was applied to the leads. When warm, the capacitor was very leaky. A 600-volt unit was used as a replacement for insurance.



Using a test CRT, the set was turned on outside of the chassis. With a heat lamp placed near the vertical section to simulate operating conditions, vertical sync held steady for over an hour and the repair was labeled a success.—*Charles B. Randall*

Rf Interference

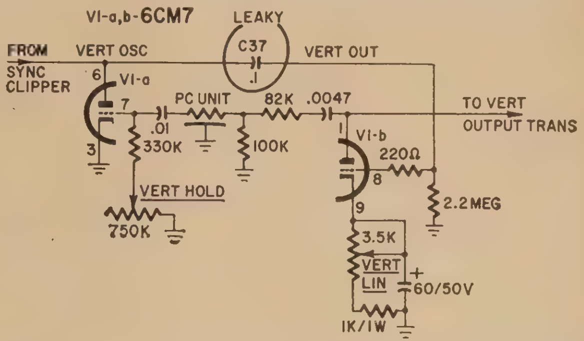
Complaint: Cross-hatch or diagonal bars in the picture, usually on channel 2. In severe cases, the picture may be reversed (negative) or even completely blanked out. Sometimes the interfering signal can be heard through the TV sound channel.

Cause: Direct pickup of fundamental, harmonic or parasitic frequencies from a transmitter.

Cure: A high-pass filter installed as close to the receiver input as possible (right on the tuner). A good ac line filter added to the high-pass filter also helps.—*C. S. Lawrence*

Zenith 15Z30 Chassis

The vertical raster was unstable, with vertical retrace lines appearing in the picture. Changing tubes did no good.



A check of the vertical sweep circuit turned up a leaky capacitor, C37. I replaced it with a good quality 600-volt unit to get the set working properly.—*William Porter*

G-E M-line Portables

I have had over a dozen of these portables in the shop in the past few years with the same trouble: the sound cuts off after the set has been playing a while. Tubes do not help. In all cases the set was repaired by replacing the ratio detector transformer (Part No. RTD-020).

I suggest that you get the transformer directly from a G-E parts distributor as other replacements have proved unsatisfactory in performance and difficult to mount on the printed board.—*R. B. Charles* END

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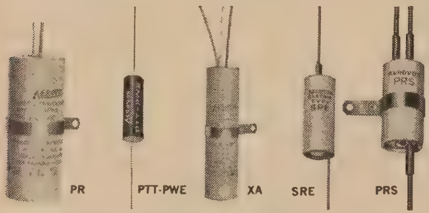

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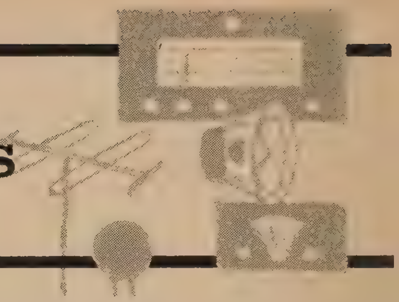

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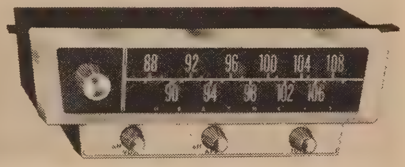

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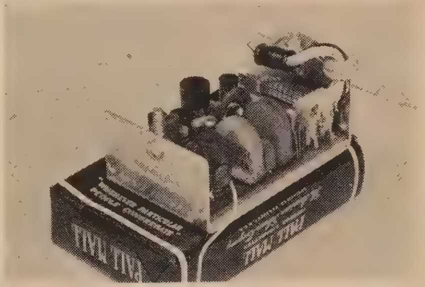

CB TRANSCEIVER, *model GW-32*. 5 crystal-controlled transmit and receive channels; superhet receiver with rf stage: built-in squelch and automatic noise-limiter functions; push-to-talk microphone. External connections for additional speaker. Built-in selective-call tone squelch permits individual call of up to 4 units on same channel. *Model GW-32,* without selective-call function.—**Heath Co.,** Benton Harbor, Mich.

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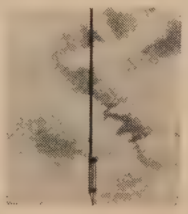
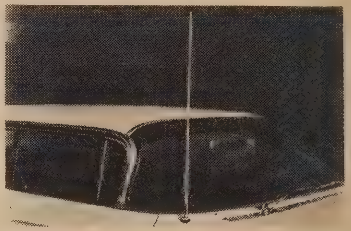


CB ANTENNAS. *Model HWC (illus.),* cowl-mounting. Accessory coupler for CB and standard AM radios. Fiberglas antenna has Mark Static Sheath plastic covering. Top-loaded, 50-ohm-load antenna design, uniform current distribution, 50-ohm match. 18 inches, 3 feet or 4 feet. For 350-, 400- and 500-kc bandwidth for 2:1 vswr. *Model HWR-42,* roof-top CB antenna, 42 inches long.—**B & K Div.,** Dynascan Corp., 1801 W. Belle Plaine Ave., Chicago 13, Ill.



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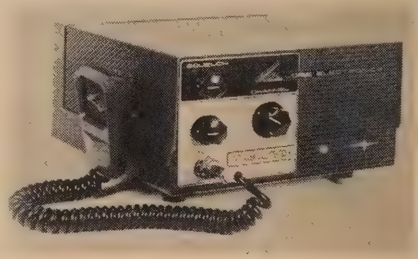

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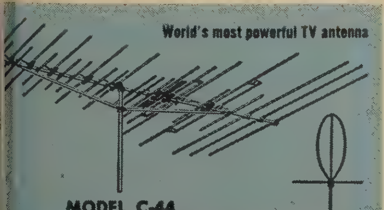

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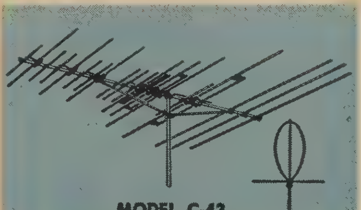

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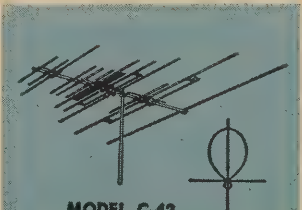

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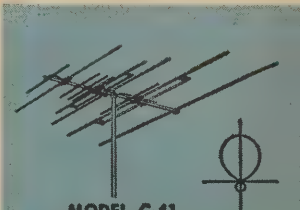

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AMPLIFIER: All transistors ● Exclusive new variable compensation circuit ● No waste power — no heat or ventilation problems ● Selection of 3 Inputs — Magnetic (with preamp built-in), crystal or ceramic, tuner or recorder ● Compact—only 3″ H x 8⅛″ L x 2⅞″ D ●

POWER SUPPLY: All silicon rectifiers ● Isolated supply circuits to accommodate 2 amplifiers ● Two 117V AC power outlets ● Master system switch ● Size 1½″ H x 8⅛″ L x 3-3/16″ D ●

PLUS: Handsome gold tone pre-finished metal cabinet ● All wire, solder, and parts with complete easy - to - follow instructions for trouble-free assembly ●

Remember, the STE system is designed specifically for enjoyment in **your** home. Possessing range of level and balance to suit your every mood, the STE Model 621 Amplifier is a truly advanced design offering all of the plus features associated with good efficient performance. Concisely, "**S**ound **T**o **E**njoy."

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☐ Complete Stereo Kit (2 Model K621 and 1 Model K621 PWR)	74.40	1.25	1.85

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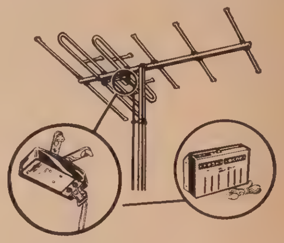
☐ **Please send me additional information on STE products.**

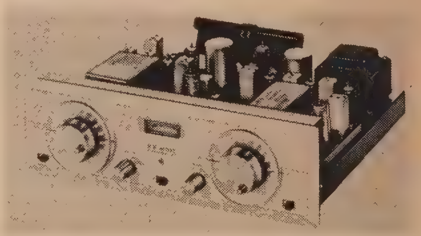
battery into 110-volt ac. 9 models, input dc voltages 6 to 110 volts, converting to 110-volt ac, 30 through 100 watts continuous.—**ATR Electronics, Inc.**, 300 E. 4th St., St. Paul 1, Minn.

TRANSISTORIZED POWER CONVERTERS. *Model 50-202 (illus.)* dual converter changes 12 volts dc (storage battery) to 110 volts, 60 cycles. Capacity 550 watts continuous, 600 watts intermittent. Remote control has variable ac output switch and signal light indicating proper ac output voltage. Filtered for use with tape recorders. 60-cycle frequency maintained to ±1-cycle accuracy regardless of changing load or input voltage. *Model 50-191,* same as above with 275 watts continuous capacity, 300 watts intermittent.—**Terado Corp.**, 1068 Raymond Ave., St. Paul 8, Minn.

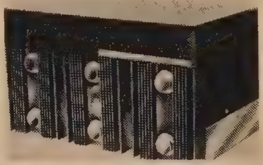
TRANSISTORIZED FM YAGI, *model TNT-FM350G-AC.* Built-in transistor amplifier integrated into Twin-Driven dipoles. 6 wide-spaced director, dipole, reflector elements individually tuned and phased. Gain 34 db. 1-inch square crossarm, ½-inch OD dipoles. Anodized aluminum. *Model AFM305,* without transistor amplifier system. *Model FM106,* amplifier system alone.—**JFD Electronics Corp.**, 6101 16th Ave., Brooklyn 4, N. Y.



AM/FM MULTIPLEX TUNER *model 333. FM section:* sensitivity 2.5 µv IHFM. FM detector bandwidth 2 mc. 3 i.f. stages, 2 FM limiting stages. *AM section:* 2 AM bandwidth positions, ferrite-core antenna, built-in tuning meter, complete tape-recorder facilities.—**H. H. Scott, Inc.**, Dept. P, 111 Powdermill Rd., Maynard, Mass.



ALL-TRANSISTOR STEREO POWER AMP, *model LA-280WX.* 200-watt unit uses 16 power transistors, 14 silicon rectifiers. Develops 100 watts music power each stereo channel into 4-ohm load, 58 watts into 8-ohm load, 33 watts into 16-ohm load. Output circuitry: 70-db feedback, 2 transistors in each half of circuitry. Frequency response ±0.1 db 15–20,000 cycles, –3 db at 80 kc minimum. Harmonic distortion less than 0.1%, IM distortion less than 0.2%. Overload recovery time 50 µsec. Channel separation 68 db minimum at 2 kc, 54 db minimum 15 cycles to 20 kc. Two high-level and 2 low-level preamp inputs. Screw type speaker terminals, stereo headphone jacks, 4 ac outlets.—**Lafayette Radio Electronics Corp.**, 111 Jericho Turnpike, Syosset, L. I., N. Y.



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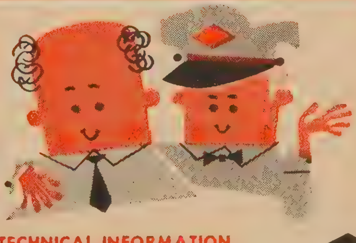

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These units work good—like an L & T Pad should—because of their small size, high wattage, and anti-backlash construction. Measuring less than 1 3/16″ deep from the mounting surface, and with 1 3/32″ diameter, they fit into any standard junction or switch box with room to spare.

In L & T Pads, though, it's what's in back that counts—and these Centralab units have exclusive "thermo-pass" insulation, which combines fast heat transfer with a high dielectric constant to achieve a conservative rating of 20 watts audio, 5 watts D.C., in a unit the size of conventional 2 watt controls.

Because of Centralab's anti-backlash construction, the "play" frequently found in dual controls is eliminated. The wiper contacts move in unison, so there's no alteration in frequency response due to variations in wiper position on the resistance tracks.

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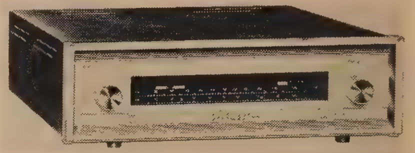
FM–MX–AM STEREO-LITE TUNER, *model S-2100.* 1-mc wide ratio detector, zero-time-constant 6BN6 gated-beam limiter. EM87 light-bar tuning indicator, flywheel tuning, front-panel-controlled afc, FM interchannel hush, wide/narrow AM selectivity. Typical sensitivity: FM: 0.95 μv for 20-db quieting. AM: 2 μv at 60% modulation for 0.5-volt output. I.f. bandwidth: FM 220 kc at 3 db, AM 5 kc at 6 db. Frequency response: FM, 20–20,000 cycles ±½ db; MX, 20–15,000 cycles ±½ db; AM (wide), 20–7,500 cycles at 6 db. 300-ohm balanced FM antenna, directable ferrite-rod AM antenna with external post. Audio output 1.4 volts at 100% FM. Power consumption 85 watts, 110–125 volts, 50-60 cycles.—**Sherwood Electronics Labs Inc.,** 4300 N. California Ave., Chicago 18, Ill.



STEREO AMPLIFIER, *model AP250.* 50 watts per channel, IHFM. Frequency response 20–20,000 cycles ±1 db. Distortion 0.6% at rated output. Hum and noise level —60 db, magnetic phono and tape; —75 db, auxiliary and tuner. Sensitivity: magnetic phono and tape 4.5 mv; tuner and auxiliary 0.5 volt. Output impedances 4, 8, 16 ohms. Outputs: speaker, tape out, third channel. Inputs: magnetic phono, tape, auxiliary, tape monitor, tuner.—**Bogen Communications Div.,** PO Box 500, Paramus, N. J.

ALL-TRANSISTOR AMPLIFIER, *model KN-450A.* 18 transistors, 2 silicon rectifiers. IHFM music power rating 100 watts, 50 watts per channel. Response ±0.5 db, 20–30,000 cycles at rated power. Distortion 0.5% at rated power; hum —90 db at tuner input, —60 db at magnetic phono input. Inputs (5 pair) magnetic, phono, tape head, tuner auxiliary, tape monitor. Outputs, 4–16 ohms per channel, 2 high-impedance for recording, headphones, center channel. **Allied Radio Corp.,** 100 N. Western Ave., Chicago 80, Ill.

STEREO/HI-FI AMPLIFIER, *model 621* (illus.). All-transistor. Variable compensation circuit. Provisions for inputs from magnetic pickup, crystal or ceramic cartridges, tuner or recorder equipment. Separate bass, treble and volume controls. Companion *model XXX 621 PWR power supply* uses silicon rectifiers, operates off 117 volts ac. 2 supply circuits for stereo operation. Both kit form or assembled.—**Southeast Technical Enterprises, Inc.,** 1107 N. Garden Ave., Clearwater, Fla.

HI-FI SPEAKER, *Hidden Magnet Model HM12K5.* Ceramic magnet mounted between basket and cone in conventional design permits use of dual cone for extended range. Epoxy resins bind magnet structure to speaker. Solderless metal binding posts; green-dot indication of voice-coil start

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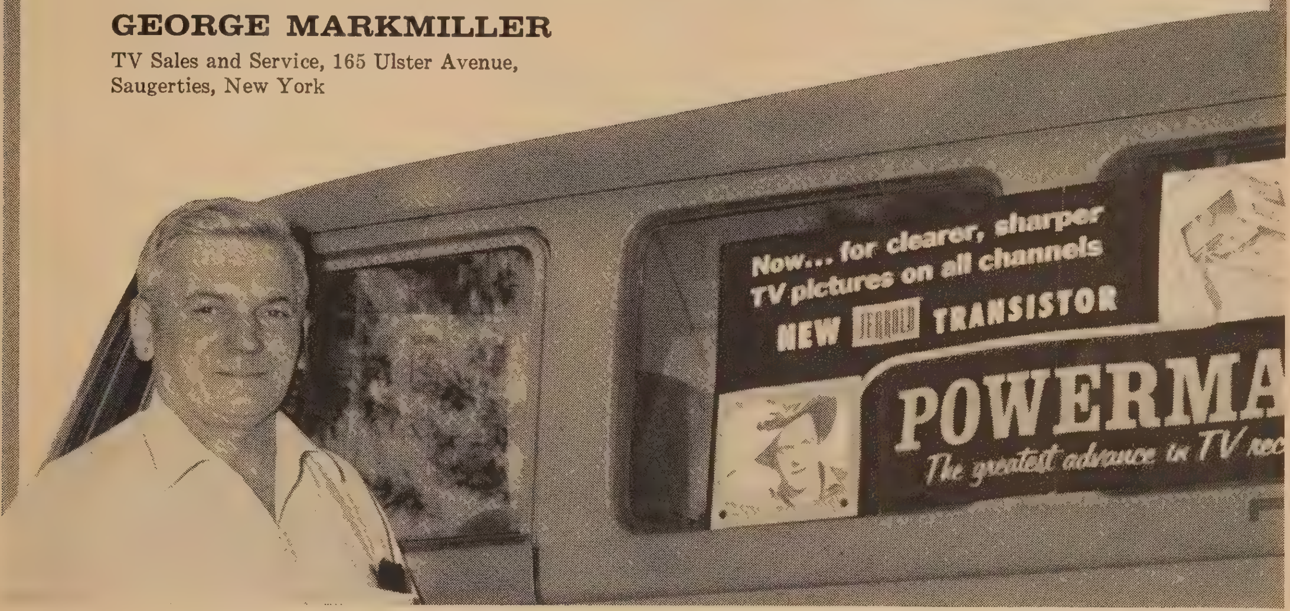
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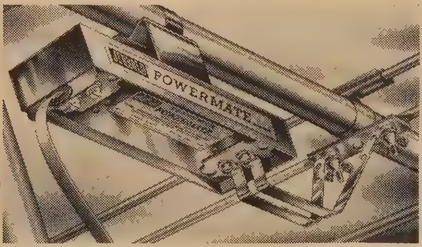

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Sy says:

Microphones—Part II

Last column we discussed the carbon microphone. This time we will discuss the crystal microphone and its cousin, the ceramic microphone.

Both the crystal and ceramic microphone are less expensive than the dynamic microphone which we will discuss in the next issue.

The crystal microphone has a high output and a good frequency response. The crystal unit consists of slabs of "Rochelle Salts" which are assembled and mounted so that the diaphragm will apply stress to the "crystal element" in accordance with the sound waves. The bending of the crystal element creates voltages on its surfaces, which are picked off by electrodes. It is a "capacitance" device having a value usually between 600 and 1,500 MMF. It is therefore, a high impedance device whose impedance varies with frequency.

The very similar ceramic microphone has most of the characteristics of the crystal unit, though the output voltage is slightly less. The ceramic unit will, on the other hand, withstand temperature and humidity ranges which might damage a crystal microphone.

Since the ceramic and crystal microphones are both high impedance devices, they can be connected directly to the grid circuit of a vacuum tube. For this reason, they are very popular for public address work, home recording and similar applications. Crystal or ceramic microphones can replace a high impedance dynamic type in most applications, although the performance may be a little different in response, range and level due partly to basic design and partly to any mismatch that might occur.

Ceramic units are not susceptible to nearby magnetic hum fields such as those from the amplifier chassis and this might favor the substitution.

In "exchanging" units, it is always important to compare the stated levels, response ranges and recommended load impedances. Don't go too far afield.

The Astatic Corporation offers a number of crystal and ceramic microphones. The newest being a ceramic mobile microphone Model 511 for Citizen Band application. The Astatic 330 Series units, which are widely used for tape recording and mobile installations, are available in either crystal or ceramic. The famous Astatic D-104, used by Ham operators the world over, is also manufactured as ceramic or crystal.

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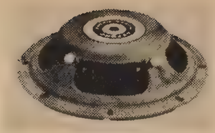
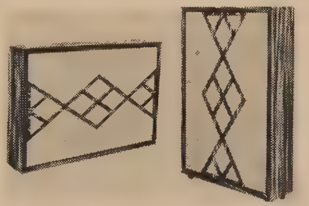


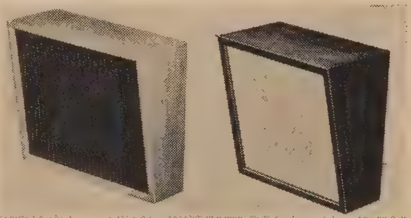
for phasing. 12-inch diameter, 3½ inches deep; 12 oz. Voice-coil impedance 8 ohms. Flux density 9,800 gauss, power handling 15 watts, response 40–15,000 cycles.—**Oxford Components,** Div. Oxford Electric Corp., 3911 S. Michigan Ave., Chicago 53

SLIM SPEAKER SYSTEM, *model SK-240WX, Decor-ette,* 4¾ inches deep. For bookshelf, floor or wall mounting, horizontal or vertical placement. 5-speaker, 3-way system contains two 8-inch woofers, 6-inch open-back mid-range driver, 3½-inch cone type tweeter, dome lens type compression tweeter. Overall frequency response 40–20,000 cycles. Power handling capacity 30 watts continuous, 60 watts peak. Impedance 8 ohms.—**Lafayette Radio Electronics Corp.,** 111 Jericho Turnpike, Syosset, L. I., N. Y.

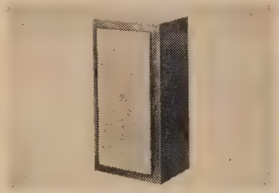


4-INCH-THIN SPEAKER SYSTEM, Syl-o-ette. Ultra-Linear response 8-in woofer, 6-½-in mid-range and subsidiary tweeter-radiator. Selected-density woofer diaphragm. Crossover 500 cycles, response 40–20,000 cycles. Power-handling capacity 30 watts maximum, integrated program material. Amplifier power requirements 10 watts. Interchangeable decorative grille cloths and frames. —**University Loudspeakers,** 80 S. Kensico Ave., White Plains, N. Y.

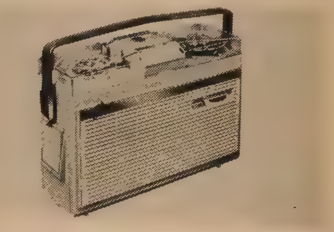
WALL BAFFLES. For 8- or 12-inch speakers. Baffles only, speaker-mounted, or speaker-and-transformer mounted. 2 wall hangers, 4 speed nuts. 7-ply hardwood construction. 6 models, selection of finishes and sizes.—**Quam-Nichols Co.,** Marquette Rd. and Prairie Ave., Chicago 37, Ill.



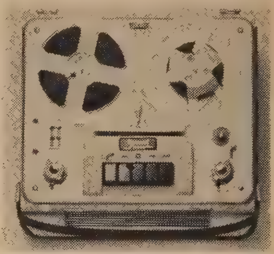
SPEAKER KIT, *model SK-4.* Patterned after manufacturers' S-3 speaker. 3-way system has high-compliance, low-resonance woofer; separate mid-range, high-frequency drivers. Multiple crossover network, separate controls for mid-range and tweeter drivers. Factory-assembled cabinet.—Dept. P., **H. H. Scott Inc.,** 111 Powdermill Rd., Maynard, Mass.



TRANSISTORIZED TAPE RECORDER, *Continental 100, model EL3585.* 2-track, 1⅞ ips. Portable, battery-operated. Takes 4-inch reels with lid off, 3-inch with lid on. Frequency response 100-6,000 cycles; signal-to-noise ratio better than 40 db. Mike, phone, tuner inputs, 3 mv, 2,000 ohms. Output to external amplifier 1 volt, 1,000 ohms (adjustable). Six 1.5-volt D-batteries, power consumption 1.1 watts, battery life approximately 20 hours. Dynamic cardioid mike. Visual battery/modulation indicator, capstan flywheel drive.—**North American Phillips Co., Inc.,** 230 Duffy Ave., Hicksville, N. Y.



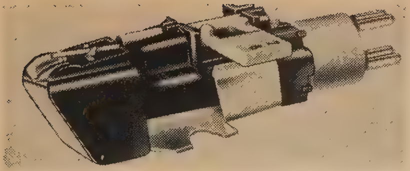
PORTABLE TAPE RECORDER, *Proton Model 94.* 2-speed unit records/plays 4-track stereo and monaural; plays 2-track stereo and monaural. Dual 4.5-watt stereo amps (9 watts monaural); dual stereo Magic Eye, 2-channel balance control; bass control; edit control. Response 30–15,000 cycles ±2 db at 7½ ips, 40–9,000 cycles ±2 db at 3¾ ips. Signal-to-noise ratio better than 50 db. Flutter and wow less than 0.12% at 7½ ips. Hysteresis synchronous motor.—**American Foreign Industries, Inc.,** 640 Sacramento St., San Francisco 11, Calif.



AMPLIFIER SHUTOFF, *Stop-O-Matic.* Turns off amplifier automatically when changer stops. Bypass switch permits use of amplifier with tuner or tape recorder without turning changer on. Outlets for changer and amplifier, ac line cord. Other electrical devices can be shut off when last record has played by inserting cube tap into amplifier outlet. *Model HFS-1* for European changers, *HFS-1* for US changers.—**Robins Industries Corp.,** 36-27 Prince St., Flushing 56, N. Y.

PLAYBACK ARM, *model 980. Dyna Lift* self-lifting device removes arm from record at end of play. Calibrated knob dials any stylus force 0-8 grams, accuracy ±0.1 gram. Linear-torque coil spring acts directly on pivot shaft at center of arm's mass for dynamic balance. Vertical and lateral precision ball-bearing suspensions. Fundamental resonance frequency 8 cycles. 5-wire circuit eliminates ground loops.—**Empire Scientific Corp.,** Garden City, N. Y.

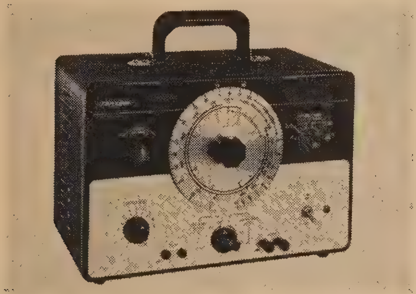
CERAMIC REPLACEMENT CARTRIDGES. Turnover type, all speeds, stereo/mono. *Model 16TA (illus)*: Channel separation 25 db; response ±1 db 20–10,000 cycles, smooth rolloff to 12,000 cycles. Compliance 2.4×10^{-6} cm/dyne, tracking



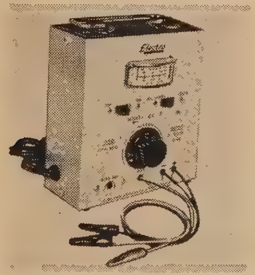
force 4 to 6 grams in professional arms, 5 to 7 grams in changers. Output 0.65 volt. *Model 18TE*: Same specs, output 1 volt.—**Sonotone Corp.**, Elmsford, N. Y.

½-MIL AUDIO TAPE. Tensilized Mylar base, oxide coating. Standard 3-, 5- and 7-inch reels with 300-, 1,200- and 2,400-foot lengths, respectively. 3¼-inch reel containing 600 feet of ½-mil tape.—**Sarkes Tarzian, Inc.**, Magnetic Tape Div., E. Hillside Dr., Bloomington, Ind.

SINE/SQUARE-WAVE GENERATOR, *model E-330* Covers 7 cycles to 750 kc, sine and square wave, in 6 bands. Amplitude control: potentiometer and 60-db attenuator switch, variable in 20-db steps. Frequency accuracy ±5%. Output impedance 0-3,000 ohms in × 1 position, approximately 67 ohms in × 0.1, × .01, × .001 positions. Power requirements 117 vac, 50-60 cycles. *Sine wave*: output 0-10 volts rms across 600-ohm load; max. power output approximately 160 mw into 600 ohms; distortion less than ¼%, 20-20,000 cycles; frequency response flat within ½ db 120 cycles to 120 kc, within 1 db 7 cycles to 705 kc, 1 db band to band. *Square wave*: output (peak to peak) 20 volts, high impedance. Rise time less than 0.15 μsec.—**Precision Apparatus Co., Inc.**, 70-31 84th St., Glendale 27, L. I., N. Y.

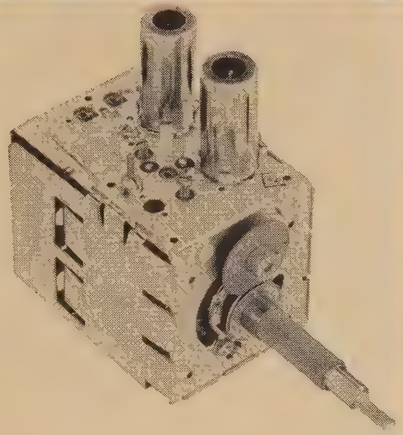


DC POWER SUPPLY, *model EC-3*. Operates all portable transistor radios. Bias tap control fully adjustable 0–6 volts, complete filtering. Delivers 150 ma at 0–20 volts; 100 ma at 24 volts. Edge-reading meter indicates output voltage or current.—**Electro Products Labs, Inc.**, 6120 W. Howard St., Chicago 48, Ill.



PORTABLE VOLTMETERS, *models 825-DC, (illus) 835-AC*. Suspension movement. 6-13/32-inch mirror scale, knife-edge pointer, fully open meter front with top and side natural lighting. 7⅝ x 6-7/16 x 3¾ in.—**Triplett Electrical Instrument Co.**, Bluffton, Ohio.

(Continued on page 96)



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Tarzian-made tuners are identified by this stamping. When inquiring about service on other tuners, always give tube complement . . . shaft length . . . filament . . . voltage . . . series or shunt heater . . . IF frequency . . . chassis identification. All tuners repaired on approved, open accounts. Check with your local distributor for Sarkes Tarzian replacement tuners, replacement parts, or repair service.

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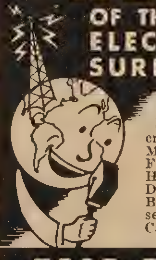

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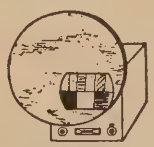

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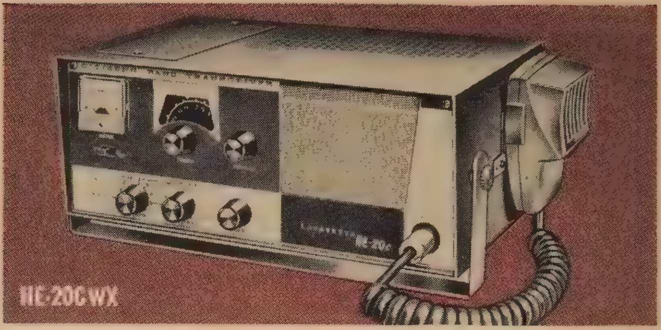

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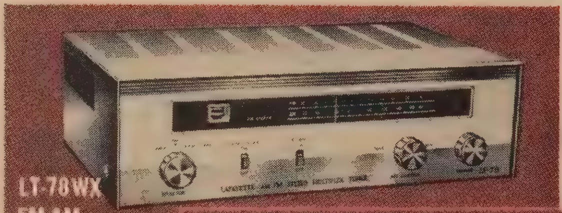

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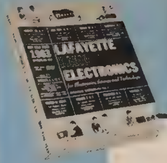

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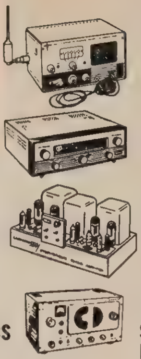

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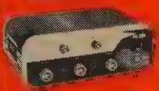

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(Continued from page 91)

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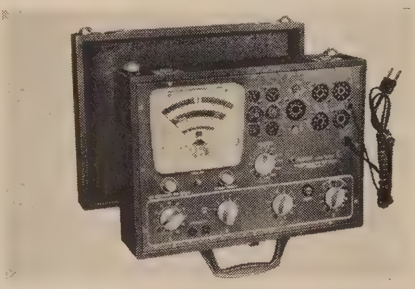
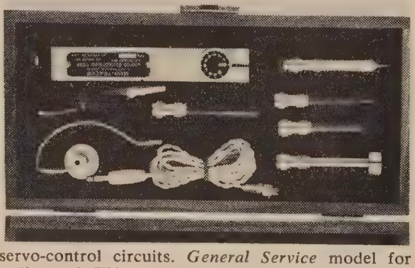
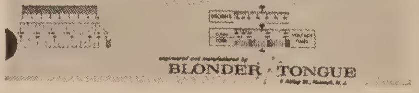


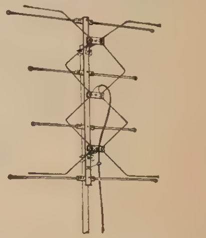
SIGNAL TRACER. Self-contained, transistorized *Mini-Tracer* pinpoints defective components, locates electrical hum, mechanical vibration in AM and FM radio, TV, communications equipment, servo-control circuits. *General Service* model for radio and TV maintenance, *Lab and Industrial* model with accessory probes.—**International Representatives Corp.,** 315 S. Beverly Drive, Beverly Hills, Calif.



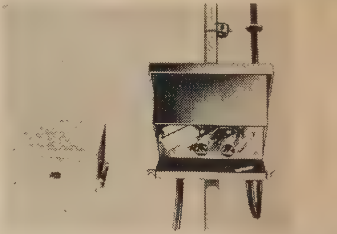
DO-IT-YOURSELF SLIDE RULE has decibel-to-voltage times conversion rule on one side, calculator of distribution system losses on other. In sheet form, to be folded and stapled into finish slide rule.—**Blonder-Tongue Labs, Inc.,** 9 Alli St., Newark, N. J.



UHF TV ANTENNA uses multi-resonant c linear reflector system. All aluminum with sa phire blue rustproof anodized finish. *Model S 1483* for uhf channels 14-83; *model SA-7083* peak for channels 70-83.—**Antennacraft Co.,** Burlingto Iowa.



MAST-MOUNTED UHF TV BOOSTER, *U Series.* Broad-band amplifier, remote power supp permits mounting unit on roof without power ou let. 14-db gain on all uhf channels. 300-ohm inpu 75-ohm output. 5 models cover channels 14–29, 2 40, 41–55, 56–69, 70–83.—**Blonder-Tongue Labs,** Alling St., Newark, N. J.



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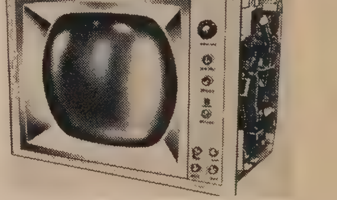

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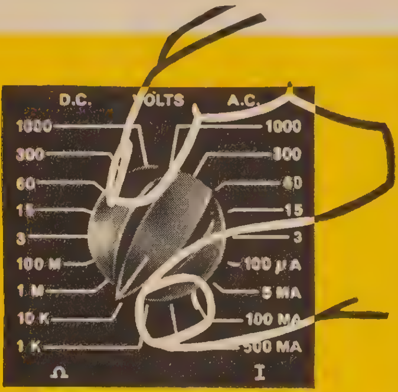

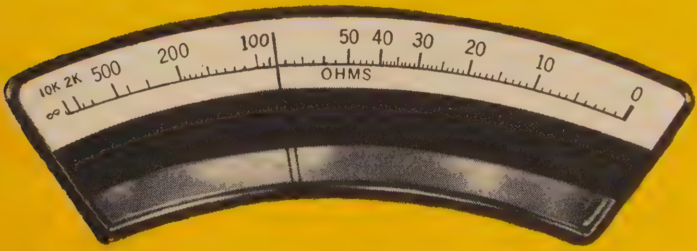

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Once you set the range switch, you automatically see only the scale you want and read the exact answer directly. Saves time, eliminates calculation, avoids errors. Individual full-size direct-reading scale for each range. Simplifies true reading of peak-to-peak voltages of complex wave forms in video, sync and deflection circuits, pulse circuits, radar systems, etc. Includes DC current ranges, too.

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CATALOGS • BOOKLETS • CHARTS

Any or all of these catalogs, bulletins, or periodicals are available to you on request direct to the manufacturers, whose addresses are listed at the end of each item. Use your letterhead—do not use postcards. To facilitate identification, mention the issue and page of RADIO-ELECTRONICS on which the item appears. UNLESS OTHERWISE STATED, ALL ITEMS ARE GRATIS. ALL LITERATURE OFFERS ARE VOID AFTER SIX MONTHS.

ELECTRONIC PRODUCTS, approximately 300 pages of them, displayed in fully illustrated *Catalog FR-62.* Products include chemical supplies, test equipment, knobs, resistors, communications and CB products, TV antennas and hardware, audio equipment, mikes and mike accessories.—**GC Electronics,** 400 S. Wyman St., Rockford, Ill.

TUBE DATA. 8-page *form No. ICE-197B* gives USA direct replacement or similar type for 800 foreign receiving tubes used in AM and FM radios, TV sets, audio amplifiers. **10¢.** *Form No. 1275K,* revised 63-page *Receiving Tubes and Picture Tubes* booklet, contains classification chart, application guide. Revised characteristic chart gives operating conditions and basing diagrams on 1050 receiving tubes, black-and-white, color picture tubes. Free from distributors, or send **50¢** to manufacturer.—**RCA,** Commercial Engineering, Electron Tube Div., Harrison, N. J.

FEED-BAK STABILIZER, *model 8961,* described in data sheet. Minimizes feedback howl and ringing in PA systems. Photo, frequency chart, specs and full operational details.—**Audio Electronic Products,** H. A. Roseberry & Son, Inc., 12750 Mansfield, Detroit 27, Mich.

TOP-HAT RETAINERS, to secure plug-in tubes, relays, capacitors and other electronic components under severe shock and vibration, presented in 8-page brochure. Photos and complete specs included.—**U. S. Engineering Co.,** Div. Litton Industries, 13536 Saticoy St., Van Nuys, Calif.

TECHNICAL TRAINING BOOKLETS. 24-page *All Electronic Alternator System* contains many photos and diagrams, details of construction, installation, servicing, replacement parts. **$1.50.** 19-page *Profitable Transistor Radio Servicing* discusses transistor theory, radio repair, circuit description, alignment. Liberally illustrated.—**$1.00.—Motorola Consumer Products Inc.,** 9401 W. Grand Ave., Franklin Park, Ill.

AUDIO LEAFLETS. 4-page illustrated brochure describes *Ortofon* stereo cartridges and pickup arms, with photos, diagrams and full specs. Graphs show frequency response and channel separation. *Thorens* turntables, 3 models, plus professional pickup arm, presented in 6-page foldup booklet with photos and full specs.—**Elpa Marketing Industries, Inc.,** New Hyde Park, N. Y.

MINIATURE LAMPS. 12-page leaflet features specs for miniature and subminiature incandescent lamps, with life-size photos and candlepower values for all types. New listings include automotive heavy-duty lamps, subminiature Tu-Pin types. Special sections on lamp terminology and miniature lamp selection. Write on company letterhead.—**Hudson Lamp Co.,** 528 Elm St., Kearny, N. J.

AUDIO ROBOTS ARE FOR SLEEPING, 6-page foldup leaflet, discusses fundamentals of extension on-off controls for hi-fi systems. Remote control can use 2-wire line to remote speaker.—**Royce Electronic Developments Inc.,** Dept. 33, PO Box 321, Valley Stream, N. Y.

TEST EQUIPMENT presented in 6-page leaflet *Profit Builders.* Includes 7 tube testers, component substitutor, tester–reactivator, multi-purpose probe for vtvm, scope and signal tracer, multi-head adapter for checking CRT on ordinary tube tester, multi-tracer signal injector and demodulator probe. Photos and full descriptions.—**Mercury Electronics Corp.,** 111 Roosevelt Ave., Mineola, N. Y.

SOUND-TO-SLIDES BOOKLET illustrates new technique for adding sound to 35-mm slides. 5-page foldup leaflet, *Make "Talkies" Out Of Your Slides,* describes method using pencil mark on oxide face of recording tape to actuate change mechanism in projector.—**General Techniques Inc.,** Dept. R62, 1270 Broadway, New York 1, N. Y.

PA EQUIPMENT offered in 8-page illustrated *Catalog 562.* Shows line of loudspeakers, mike stands, accessories. New products include *Special-duty* weatherproof speakers, *Columair* sound columns for improved reproduction in trouble areas.—**Atlas Sound Div.,** American Trading & Production Corp., 1419-51 39 St., Brooklyn 18, N. Y.

DYNAMIC MICROPHONE, *model 513H,* described in 2-page, single-sheet data bulletin. Life-size photo plus details of output, response, switch, cable, housing material and finish.—**Astatic Corp.,** Conneaut, Ohio.

HI-FI–STEREO–TV EQUIPMENT shown in 19-page 10½ x 4½-inch catalog. 20 units include FM stereo sets, stereo–TV–tape recorder combos, speakers, storage cabinets. Technical data and photo of each unit.—**Clairtone Sound Corp., Ltd.** Time & Life Bldg., Rockefeller Center, New York 20, N. Y.

BARRY'S GREEN SHEET, *Winter Edition,* offers electronic tubes, semiconductors, transformers, chokes, meters, wire, test equipment, industrial equipment—includes many hard-to-find items.—**Barry Electronics Corp.,** 512 Broadway, New York 12, N. Y.

PROFESSIONAL CONDENSER MICROPHONES described in 14-page catalog, with specs and characteristics of 14 Schoeps models. Includes power supplies, accessories, complete mike systems. Request on company letterhead.—**International Electroacoustics Inc.,** 333 6th Ave., New York 14, N. Y.

TV TUBE TROUBLE CHART contains 22 illustrations of picture defects to help locate bad tubes. Condensed tube substitution guide covers tubes in general use. Also available 1963 catalog of TV, radio and hi-fi service books. Send self-addressed, stamped envelope.—**Harry G. Cisin Publisher,** Amagansett, N. Y.

ELECTRONIC COMPONENTS, 1963 Allied *Catalog 220,* 456 pages. Products include audio and hi-fi equipment, CB supplies, intercoms, mikes and accessories, PA products, test instruments, tape recorders, etc.—**Allied Radio,** 100 N. Western Ave., Chicago 80, Ill.

ELECTRONIC COMPONENTS offered in Lafayette 1963 *Catalog 630.* 388 pages of equipment include stereo hi-fi components of major firms, CB equipment, optics, books, tools, radio and TV parts and accessories. Many illustrations.—**Lafayette Radio Electronics Corp.,** 111 Jericho Turnpike, Syosset, N. Y.

RADIO TRANSISTOR REPLACEMENT Guide, *ETR3345,* 17 x 22-inch wall chart cross-references manufacturer's 8 basic "universal" replacement transistors with 1,218 types commonly used.—**General Electric Co.,** 3800 N. Milwaukee Ave., Chicago, Ill.

MASTER TV MANUAL. 14-page selection guide for systems and equipment. Covers smaller systems only, with diagrams and descriptions of typical installations in homes, TV showrooms, service shops, apartment houses and institutions. Section on multi-set home installations.—**Blonder-Tongue Labs,** 9 Alling St., Newark 2, N. J.

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1J3	.79	6BA6	.50	6SK7GT	.95	12DL8	.88
1K3	.79	6BC5	.61	6SL7GT	.84	12DQ6	1.04
1R5	.77	6BC8	1.04	6SN7	.65	12DS7	.84
1S5	.75	6BE6	.55	6SQ7GT	.94	12DT5	.76
1T4	.72	6BF5	.90	6T4	.99	12DT7	.79
1U5	.65	6BF6	.44	6T8	.85	12DT8	.78
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2AF4	.96	6BH8	.98	6V6GT	.54	12DZ6	.62
3AL5	.46	6BJ6	.65	6W4	.61	12ED5	.62
3AU6	.54	6BJ7	.79	6W6	.71	12EG6	.62
3AV6	.42	6BK7	.85	6X4	.41	12EK6	.62
3BC5	.63	6BL7	1.09	6X8	.80	12EL6	.50
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4BQ7	1.01	6CM7	.69	9CL8	.79	12SN7	.67
4CS6	.61	6CN7	.70	11CY7	.75	12SQ7GT	.91
4DT6	.55	6CQ8	.92	12A4	.60	12U7	.62
4GM6	.60	6CR6	.60	12AB5	.60	12V6	.63
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5BK7	.86	6CY5	.70	12AF3	.73	18FW6	.49
5BQ7	1.01	6CY7	.71	12AF6	.67	18FX6	.53
5BR8	.83	6DA4	.68	12AJ6	.62	18FY6	.50
5CG8	.81	6DE6	.61	12AL5	.47	19AU4	.87
5CL8	.76	6DG6	.62	12AL8	.95	19BG6	1.39
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5EA8	.80	6DK6	.59	12AT6	.50	19T8	.85
5EU8	.80	6DN6	1.55	12AT7	.76	21EX6	1.49
5J6	.72	6DQ6	1.10	12AU6	.51	25AX4	.70
5T8	.86	6DT5	.81	12AU7	.61	25C5	.53
5U4	.60	6DT6	.53	12AV6	.41	25CA5	.59
5U8	.84	6DT8	.94	12AV7	.82	25CD6	1.52
5V6	.56	6EA8	.79	12AX4	.67	25CU6	1.11
5X8	.82	6EB5	.73	12AX7	.63	25DN6	1.42
5Y3	.46	6EB8	.94	12AY7	1.44	25EH5	.55
6AB4	.46	6EM5	.77	12AZ7	.86	25L6	.57
6AC7	.96	6EM7	.82	12B4	.68	25W4	.68
6AF4	1.01	6EU8	.79	12BD6	.50	32ET5	.55
6AG5	.70	6EV5	.75	12BE6	.53	35C5	.51
6AH4	.81	6EW6	.57	12BF6	.60	35L6	.60
6AH6	1.10	6EY6	.75	12BH7	.77	35W4	.42
6AK5	.95	6FG7	.69	12BK5	1.00	35Z5	.60
6AL5	.47	6FV8	.79	12BL6	.56	36AM3	.36
6AM8	.78	6GH8	.80	12BQ6	1.16	50B5	.69
6AQ5	.53	6GK5	.61	12BR7	.74	50C5	.53
6AS5	.60	6GK6	.79	12BV7	.76	50EH5	.55
6AT6	.49	6GN8	.94	12BY7	.77	50L6	.61
6AT8	.86	6H6	.58	12BZ7	.86	70L7	.97
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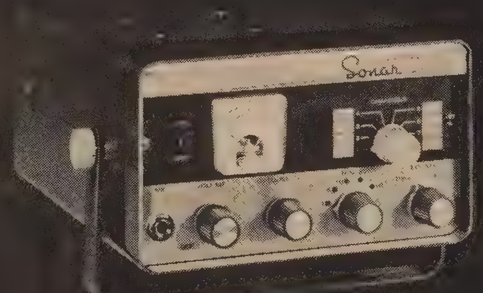

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TECHNICIANS' NEWS

Training Program Outline

Des Moines, Iowa—The TESA-Iowa training program is ready to swing into action. Tape and slides will be used to cover 14 subjects for all Iowa branches. An outside instructor is available if needed. The sequence of subjects is:

1. Dc fundamentals.
2. Ac fundamentals.
3. Basic theory and applications of tubes.
4. Basic theory and applications of transistors.
5. Power supplies.
6. Sound systems.
7. Electromagnetic waves and transmission practices.
8. Rf amplifiers and detectors.
9. AM transmitters and receivers.
10. FM transmitters and receivers.
11. Antennas, waveguides and transmission lines.
12. Complex waveforms.
13. Test equipment.
14. Servicing procedures for AM, FM and transistor radios; black-and-white and color TV; audio, stereo and commercial sound gear; industrial equipment and special items.

New Service Code

Fresno, Calif.—The county's television service firms have adopted a Standards of Practice Code for TV service technicians. Those subscribing to the code are bound to include the full name and address of their business on all advertising, invoices and statements; give itemized statements showing all costs, both labor and parts; take a set to the shop only when necessary; carry insurance to protect themselves and their customers, and return all parts that have been replaced to the customer except for picture tubes and parts that have been exchanged under warranty.

Extended Warranties the Target

Harrisburg, Pa.—A mass meeting sponsored by the Federation of Television & Radio Service Associations in the Hotel Harrisburger set its sights on getting the views of service dealers toward warranties and the plans of some manufacturers to extend these warranties even further.

FTRSA officials say that any program of extending warranties is of vital importance to dealers and, if put into effect on a wide scale, may spell the demise of the independent service dealer. The particular problem is the extension or proposed extension of existing 90-day warranties to as much as 1, 2, 3 or even 5 years.

NATESA Convention

Chicago, Ill.—Elected were Irv Toner, president; Larry Dorst, secretary general; H. O. Eales, treasurer; A. Edward Stevens, eastern vice president; Paul Segars, eastern secretary; Lyle Green, east central vice president; Charles LaRoche, east central secretary; Earl Steffes, west central vice president; Bill Childs, west central secretary; Pat Barr, western vice president; Les Quigley, western secretary, and Frank Moch, executive director.

Friends of Service awards were voted Finney, G-E, Philco, RCA, Raytheon, Sams, Sylvania, Tung-Sol and Zenith.

The single Spring Directors Conference was replaced by four simultaneous divisional meetings, to be held in April.

Techs Run Co-op Service Ad

Columbus, Ga.—Twenty-two RTSA member firms got together to run a 2-column 7½-inch ad in the classified section of the Sunday *Ledger-Enquirer*. The ad read—"Dependable TV repairs! Call a member of the Radio-Television Service Association, qualified TV technicians. Sensibly priced service. Factory new guaranteed parts." Then the 22 firms were listed in alphabetical order. At the very bottom of the ad was the line—"Always ask—'Are you a member of RTSA?' "

Rebuilt Color CRT's

Los Angeles, Calif.—Technicians on the West Coast can now buy rebuilt color picture tubes from Pico Electronics. According to the firm's president, Max Karp, "Over the past few months our stores have received so many requests for rebuilt color tubes, we decided to expand our operations and become the first, to our knowledge, color picture-tube rebuilder in Southern California."

"This move," Karp continued, "was not easy. Rebuilding a color tube is a custom job."

Pico, which sells only to dealers, also announced that they would rebuild any dealer's color dud within a week.

Microwave Glossary

Calorimeter—Device to keep tabs on calories for overweight engineers.
Maser—A suppressed masher
Cavity—A hole in a tooth.
Waveguide—Directs ocean waves at the seashore to encourage surfboarding.
Microwave—A small wave that must be directed by waveguide (see above) to make it suitable for surfboarding.
Anechoic—An old-fashioned earache.
Magnetron—A magician's magic wand.
Klystron—Chinese for try it on.

BOOST YOUR BRITENER SALES
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SIX MAGIC WORDS
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WOULD YOU LIKE A BRIGHTER PICTURE?

That's a question with only one possible answer—YES. Every customer wants a better, brighter picture . . . but doesn't realize how easy it is to get one.

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On every service call, remember to use Perma-Power's 6 Magic Words—Would You Like A Brighter Picture? You'll sell a 12-pack of Briteners almost as fast as you can say Perma-Power!

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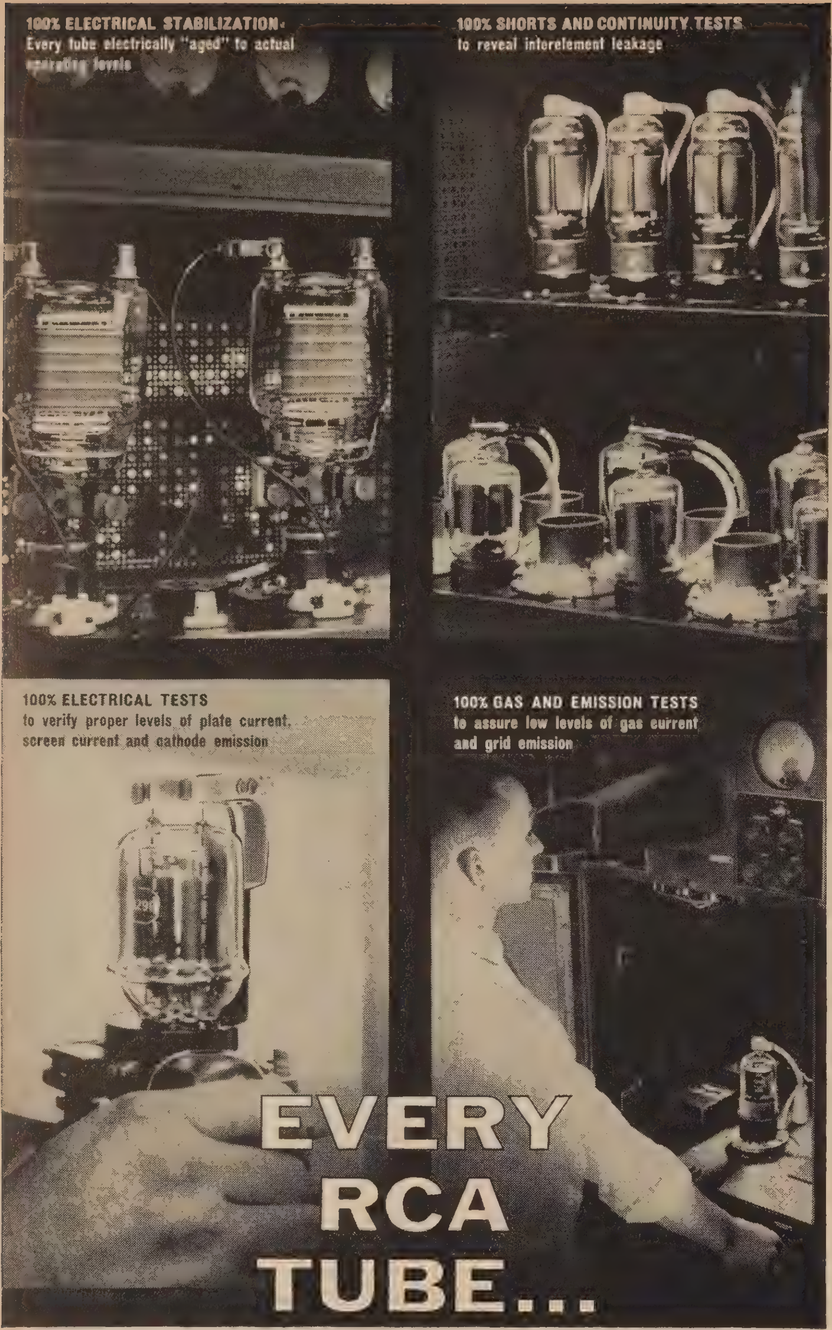
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100% SHORTS AND CONTINUITY TESTS
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100% ELECTRICAL TESTS
to verify proper levels of plate current, screen current and cathode emission
100% GAS AND EMISSION TESTS
to assure low levels of gas current and grid emission
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You take no chances when you replace with RCA communications tubes. *Every single tube,* before leaving our plant, is electrically aged and tested for major electrical characteristics. A tube failing one single test is automatically rejected and destroyed.

You cannot buy an untested RCA POWER TUBE!

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Duplexer—Device for expanding small apartments.
Ferrite—Small ferryboat.
Noise Generator—Talkative female.

DA Reports

Santa Clara Valley, Calif.—Assistant District Attorney Louis C. Doll told SCV Chapter members of CSEA at their general meeting at Los Gatos Lodge that only one or two complaints on TV servicing had been handled by his office during the past five or six months. Doll went on to credit close cooperation between the association and the DA's office for the lack of complaints.

◆

50 Years Ago

In Gernsback Publications

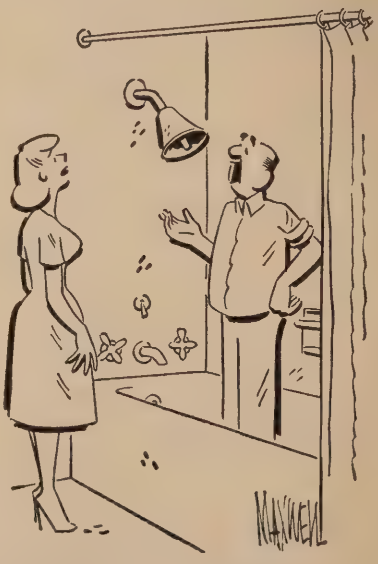
HUGO GERNSBACK, *Founder*

Modern Electrics	1908
Wireless Association of America	1908
Electrical Experimenter	1913
Radio News	1919
Science & Invention	1920
Practical Electrics	1921
Television	1927
Radio-Craft	1929
Short-Wave Craft	1930
Television News	1931

Some larger libraries still have copies of Modern Electrics on file for interested readers.

In November, 1912, *Modern Electrics*

The Average Ship's Wireless, by Stanley E. Hyde.
The Helsby Wireless Detector, by Frank C. Perkins.
The Wireless Law (Public—No. 264).
A Galena Detector, by W. F. Hall.
The Simplest (Tuning) Slider, by E. R. Anschutz.
Taps for Loose Coupler Windings, by Otto Stach.
Portable Wireless Receiving Outfit.
A Simple Variable Condenser, by Paul Horton.
Marconi Demonstrates High Speed Transmission.



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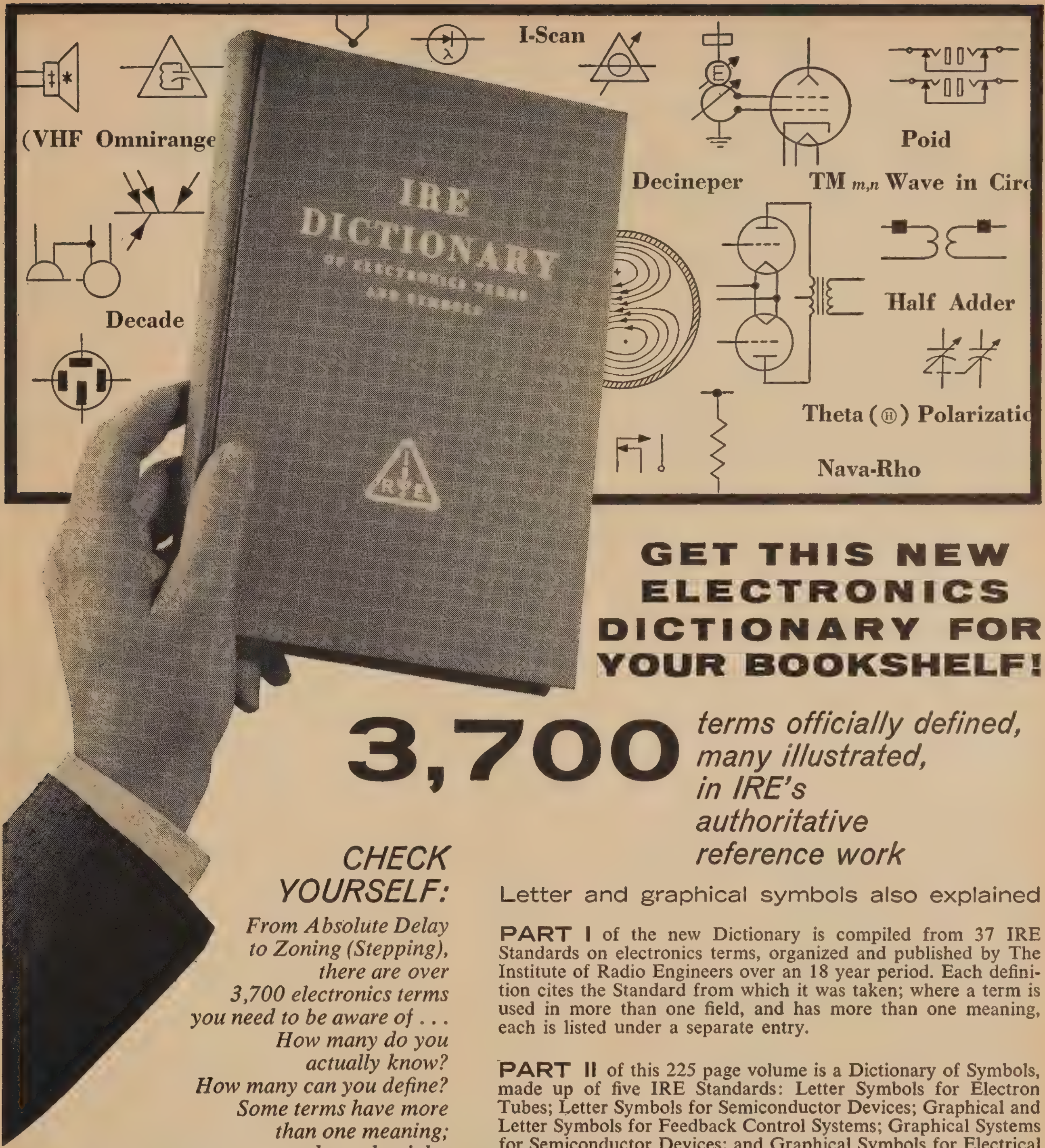

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PART II of this 225 page volume is a Dictionary of Symbols, made up of five IRE Standards: Letter Symbols for Electron Tubes; Letter Symbols for Semiconductor Devices; Graphical and Letter Symbols for Feedback Control Systems; Graphical Systems for Semiconductor Devices; and Graphical Symbols for Electrical Diagrams. A four-page index to graphical symbols is included.

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2	200	.44	50	10	1.49
2	400	.77	50	25	1.95
2	600	.88	50	50	2.88
2	800	1.49	50	100	3.95
12	50	.88	50	200	4.49
12	100	.99	100	10	1.95
12	200	1.25	100	25	2.49
12	400	1.88	100	50	3.50
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35	50	1.77	100	200	4.97
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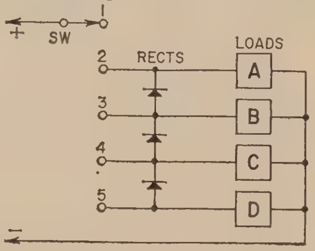
NOTEWORTHY CIRCUITS

Simplified Additive Power Switching

In a number of communications and industrial electronic installations, additive switching circuits make life complicated for the technician.

This problem arises when the control data sheet calls for a switch that turns on device A in position 1, devices A and B in position 2, devices A, B, and C in position 3, etc. This normally requires either a "successive make" switch, which you can find in the catalogs but usually not at your supplier's, or a separate switch wafer for each device to be switched. If the switching is to be remote, as by a telephone type stepping switch, circuitry becomes prohibitively costly or complicated.

Solid-state rectifiers with a very small voltage drop simplify this problem greatly, making possible not only compact and relatively inexpensive additive switching for either local or remote use, but also switching hitherto troublesome combinations.



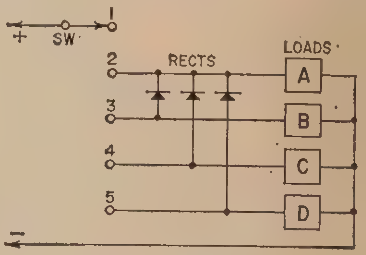
SW POS	FUNCTION
1	ALL OFF
2	LOAD A ON
3	LOADS A & B ON
4	LOADS A,B & C ON
5	LOADS A,B,C & D ON

Fig.1

The circuit of an additive switch, simplified by use of solid-state rectifiers, is shown in Fig. 1. Note that only a single switch wafer is needed. The rectifiers are compact so they may be mounted directly on the switch wafer. Only one wire from switch to each controlled device is needed.

A number of other additive circuits are possible using this general method. One sample, with a table of functions performed, is shown in Fig. 2. Many other switching circuits can be simplified by this technique. When the loads are ac-operated devices or circuits, these switching arrangements can operate dc-type control relays.

Rectifiers used here must be adequate as to voltage rating; the peak inverse rating of the rectifier must not be exceeded (off position for a given function), and forward current, including that during turn-on surges, must not exceed rectifier rating.—*Ronald L. Ives*



SW POS	FUNCTION
1	ALL OFF
2	LOAD A ON
3	LOADS A & B ON
4	LOADS A & C ON
5	LOADS A & D ON

Fig.2

Relay-less Photoelectric Announcer

This photoelectric announcer can be set up anywhere to indicate when a person or object breaks a beam of light. It has no complicated relay. As soon as the beam is broken, a PM dynamic speaker produces an audio tone determined by the builder. One battery drives the complete unit.

The circuit consists of a two-transistor oscillator biased to cutoff by a third transistor serving as a photo-sensing device. As long as the light beam is shining on the exposed wafer of the transistor, the oscillator remains at cutoff; when the beam is interrupted, the bias is effectively removed and the oscillator becomes energized.

The oscillator consists of an n-p-n transistor, V1, direct-coupled to a p-n-p power transistor, V2. The circuit requires only one capacitor for proper phasing and feedback. Resistor R and the capacitor determine oscillator frequency. R can be either variable or fixed. Photo-transistor V3 is connected from emitter to base of V2 to cut off the oscillator when light is shining on it.

Transistors V2 and V3 are Olson TR-15's similar to the 2N176, 2N235, 2N307 and 2N401. To make V3 photosensitive, remove the top of the case by drilling a small hole into it as close to the edge as possible and away from the from ALLIED

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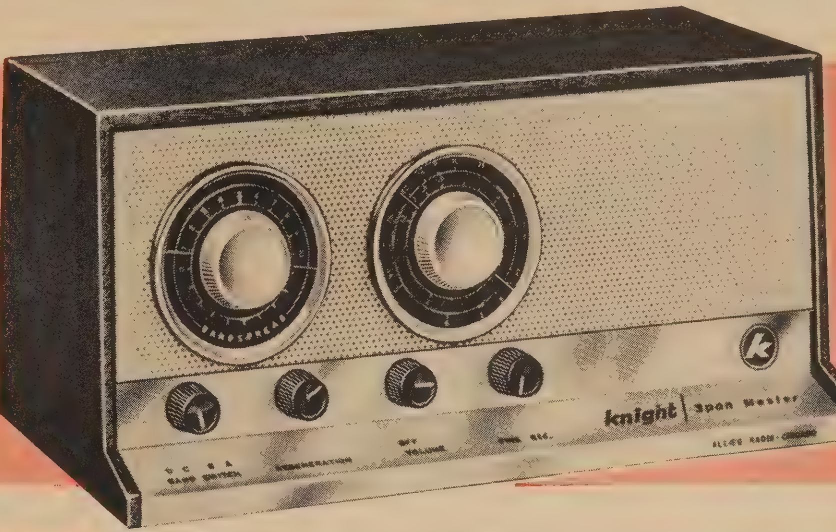

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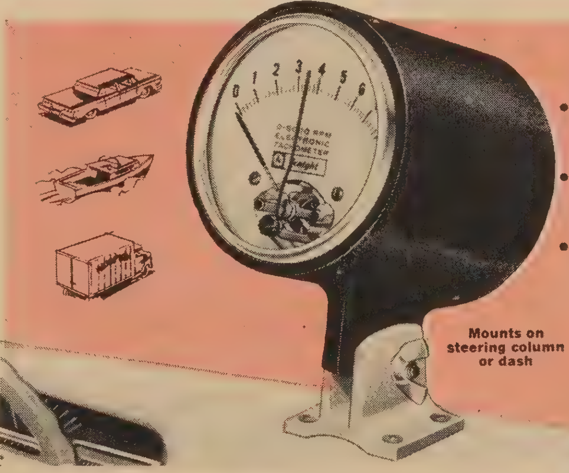

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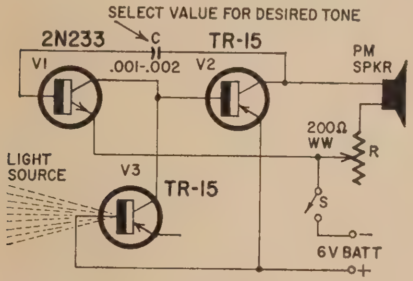
BROOKS RADIO & TV CORP., 84 Vesey St., Dept. A, New York 7, N. Y. TELEPHONE COrtland 7-2359 germanium wafer. This can be determined by examining the bottom of the transistor. The wafer is above that portion representing the greater space between terminal connections (base and emitter) and mounting end. The top then can be removed with cutting pliers as you would peel off the band around a tin container. Mount the transistor in a vise for a firm support. The top can also be removed very nicely by grinding it away slowly on a sanding disc. It can then be peeled off. [The Olson TR-19 photoelectric-power transistor looks like a good ready-made substitute for V3.—*Editor.*]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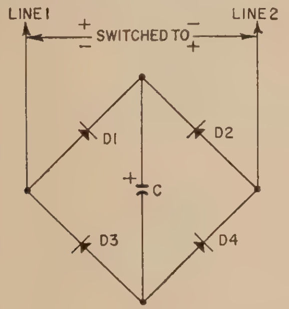
C
TR-15
V1
.001-.002
V2
PM SPKR
200Ω WW
R
LIGHT SOURCE
V3
TR-15
S
6V BATT
+

The whole unit can be mounted in one box, with V3 exposed on one side. The sensitivity depends on the amount of light falling on the wafer of V3, and therefore might require a single convex lens in front of it. The light beam, of course, will have to be concentrated with either a lens or a parabolic reflector. Since germanium is unusually sensitive to infrared, it might be used instead of white light.—*Martin H. Patrick*

Re: Nonpolarized Electrolytics

An interesting method of using an electrolytic capacitor in a nonpolarized application was published in "Noteworthy Circuits" on page 101 of the May 1962 issue. Here is another circuit which might be advantageous under some conditions. It is a variant of the familiar bridge rectifier. When line 1 is positive, diodes D1 and D4 conduct and D2 and D3 are blocked; vice versa when line 2 is positive. C has the correct polarity in each case.


LINE 1
LINE 2
+
−
SWITCHED TO
−
+
D1
D2
+
C
D3
D4

This circuit uses one less capacitor but two more diodes, so it is advantageous where a diode is cheaper than half the price of a capacitor. It also might provide worth-while space savings in some applications.—*Charles Erwin Cohn*

END

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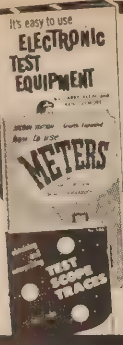

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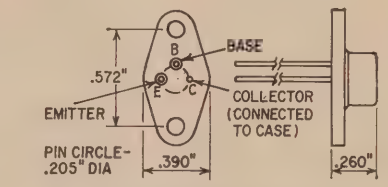

2N2282,2N2283,2N2284

	2N2282	-2283	-2284
V_{CES}	60	100	200
V_{CEO}	30	60	100
V_{CB}	60	100	200
I_C (amperes)	3	3	3
P_C (watts)	5	5	5

Characteristics at 25°C are:

h_{FE} (minimum)	30
f_{ab} (typical mc)	2.5
h_{fe} (typical)	45
t_r (μsec)	2.5
t_s (μsec)	1.5
t_f (μsec)	1.0

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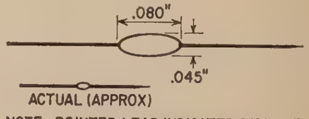

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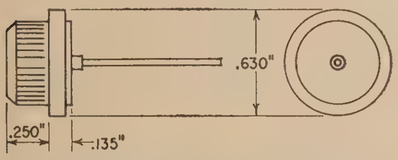
1N3491 through 1N3495

This group of press-fit rectifiers are designed to withstand current surges to 300 amperes. The knurled case allows the unit to be press-fit mounted in any position. The devices are normally supplied with the cathode connected to the case. Reverse-polarity units (identified with an R suffex) are also available.



IN3491, IN3492, IN3493, IN3494, IN3495

Electrical characteristics of these Delco rectifiers are:

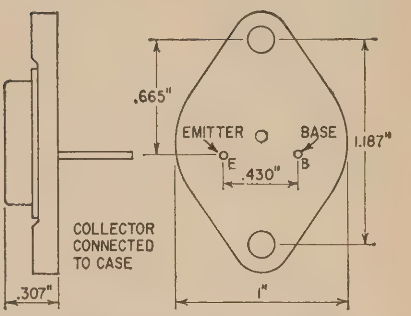
	1N3491	-3492	-3493	-3494	-3495
Max peck reverse voltage	50	100	200	300	400
Max rms voltage	35	70	140	210	280
Max continous dc blocking voltage	50	100	200	300	400
Peak one-cycle surge current (amps)	300	300	300	300	300
Max full-load reverse current (ma)	10	10	8	6	4
Max full-load forward voltage drop	0.7	0.7	0.7	0.7	0.7

2N1549, -1550, 1551, 1552

This is a group of p-n-p germanium alloy power transistors designed for use in industrial and military high-power switching, control and amplifier circuits.

Maximum ratings of these 15-amp Clevite transistors are:

	2N1549	-1550	-1551	-1552
C_{VB}	40	60	80	100
V_{CE} (at max current)	20	30	40	50
V_{EB}	20	30	40	50
I_C (amps)	15	15	15	15
I_B (amps)	5	5	5	5



2N1549, 2N1550, 2N1551, 2N1552

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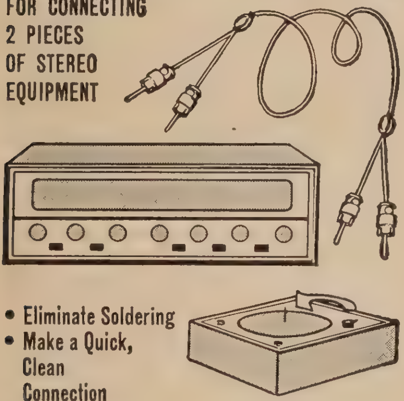

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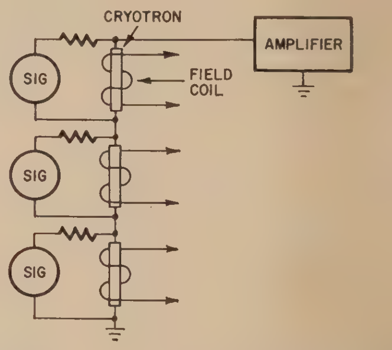
new PATENTS

Cryotron Gate

Patent No. 3,023,325

Andrew E. Brennemann, Poughkeepsie, N. Y. (Assigned to International Business Machines Corp., New York, N. Y.)

This circuit measures different electrical signals in rapid succession. The cryotrons are made of superconductive material which loses its resistance when cooled to nearly absolute zero. The cryotrons are mounted inside field coils that are pulsed successively by control currents from a computer or other source. When an electrical pulse is applied across its coil, the cryotron becomes resistive again.



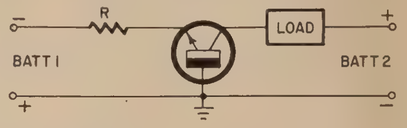
Pulses are applied across the coils in rapid succession. A pulsed unit will develop a voltage in proportion to its signal, while the other (unpulsed) cryotrons are shorted. Therefore, a single amplifier will do. Its output, at any given instant, will be a measure of the signal being applied to the pulsed cryotron.

Overload Protection

Patent No. 3,023,326

Ronald D. Cone, Bellflower, Calif. (Assigned to North American Aviation, Inc.)

This device maintains nearly constant output, so it can protect a load against excessive current. It is a common-base circuit in which the collector flow remains slightly smaller than the emitter bias.



By maintaining a fixed bias, the load current can vary only slightly.

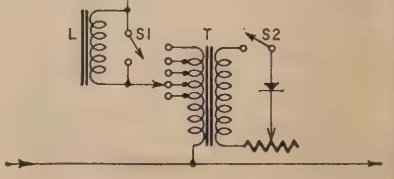
It is important that the collector be reverse-biased at all times. This requires that the collector voltage be large enough and the load resistance small enough for the particular transistor in use. The load current will rise very little even when the load is shorted.

Alarm Transmitter

Patent No. 3,035,181

Arthur Laudel, Jr., Leawood, Kans. (Assigned to USA as represented by the Office of Civil Defense)

Among important modern needs is a device to warn of impending danger, perhaps a hurricane



or air raid. This new method seems more effective than sirens or radio broadcasts. An alarm is transmitted over existing power lines, so nearly everybody can be reached immediately.

The signal comprises a harmonic of the line frequency; for example, 240 cycles at 1 volt. It is superimposed over line power and does not affect other equipment. A sensitive receiver, plugged into the line, responds to the harmonic to sound an alarm. Tests show that such a signal is effective over 200 miles and can warn more than 1,000,000 persons.

The diagram shows a harmonic generator connected (at the powerhouse) across the line.

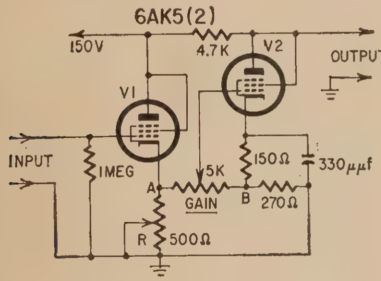
T's primary is connected through reactor L, and a rectifier is placed across the transformer secondary. When S1 is closed, the line energizes T. Rectified secondary current distorts the sinusoidal waveform and generates harmonics. The desired harmonic is accentuated by adjusting the primary taps and the variable resistor.

Direct-Coupled Amplifier Gain Control

Patent No. 3,024,424

Chester Dudziak, Riverton, N.J. (Assigned to USA, as represented by the Secretary of the Air Force)

This control adjusts gain without affecting grid bias. R is set to produce the same voltage at point A as at B. Then, as the gain control is adjusted, there can be no change in bias at the grid of V2. Component values are shown for a typical amplifier.

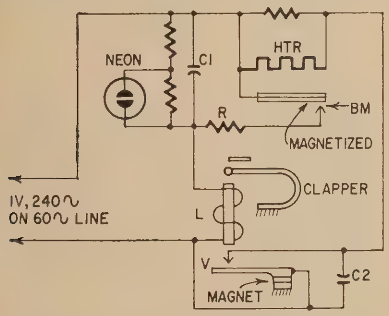


Alarm Receiver

Patent No. 3,035,251

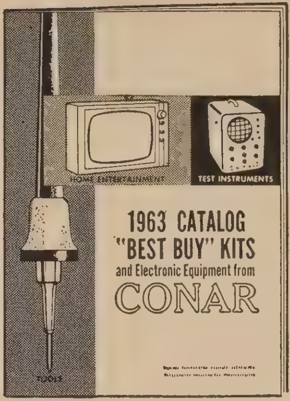
Frank H. Inderwiesen, Prairie Village, Kans. (Assigned to USA as represented by the Office of Civil Defense)

This receiver is tuned to 240 cycles and can operate on signals of 1 volt or less. It is always plugged into the line so it can respond to an alarm signal. LC1 is tuned to 240 cycles. Typical values are: L = 0.885 henry and C1 = 0.41 μf. When a harmonic (signal) appears on the line, it flows through L, causing contacts V to vibrate and close the circuit through the heater and its protective shunt. After a few seconds of heating, bimetal contacts BM close. Note that the upper contact is magnetized to assist closure.



With BM closed, the full line voltage appears across L (and limiting resistor R). The clapper vibrates against its sounder to give an audible alarm.

C2 prevents sparking across V's contacts. BM is designed so ambient changes cannot affect it. Also, because it takes time for the heater to reach operating temperature, BM cannot be affected by random, momentary pulses. END



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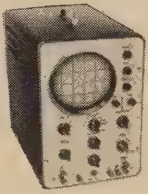

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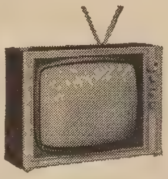

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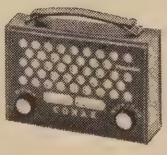

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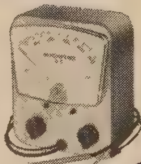

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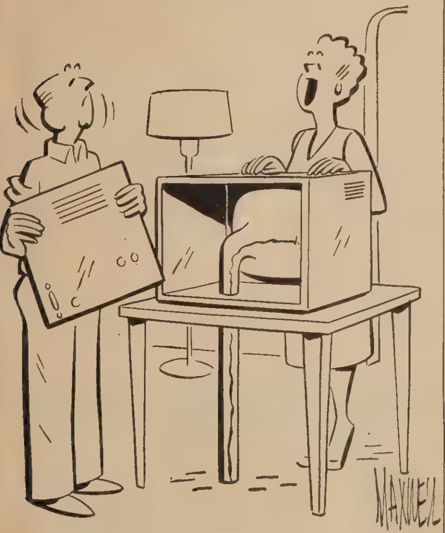

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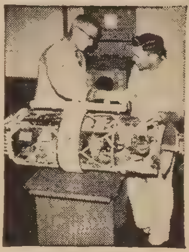

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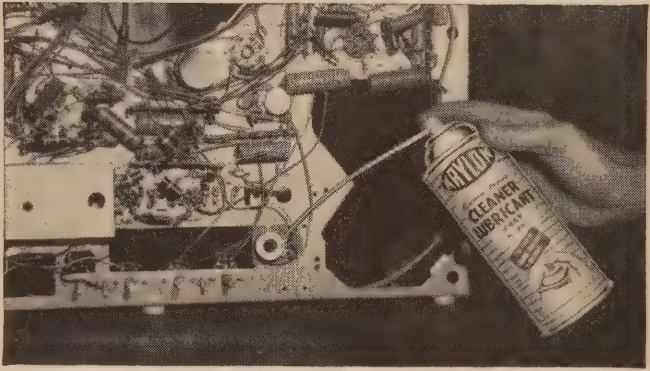

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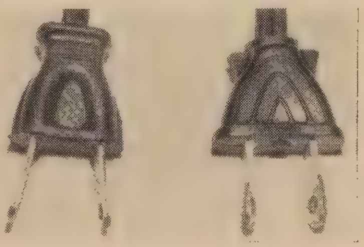
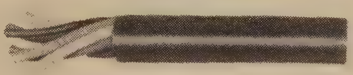
Cure for Loose Plug

Ever plug in your soldering gun, electric drill or cheater cord and have the push plug fall from the outlet or extension cord tap just as you started to do work? Here's a solution to this vexing problem. Instead of bending *out* the plug's prongs (see plug in left half of photo), for a tighter fit (to get them to fit in the outlet you usually have to bend them back anyway) grip the plug prong near its base with pliers, then using a second pair of pliers grip the end of the prong and give it a slight twist. Do the same with the other prong but twist in an opposite direction (right half of photo). This gives the plug a solid friction-tight fit so it won't fall out due to light tugs on the cord.—*John A. Comstock.*



Wiring Cables

If you're building a complex piece of electronic gear that calls for running a large number of leads side by side down one edge of a chassis, it is best to combine them into a single cable. A simple way of doing so, one that avoids buying an expensive multiconductor cable or laboriously tying the leads together, is to get a length of Alphlex shrinkable tubing in a diameter just large enough to fit over the wiring you wish to cable. Then apply heat, about 135°C, with a soldering iron or direct flame from a match, and the tubing will shrink into a tight-fitting cable jacket. —*Chester S. Lawrence*



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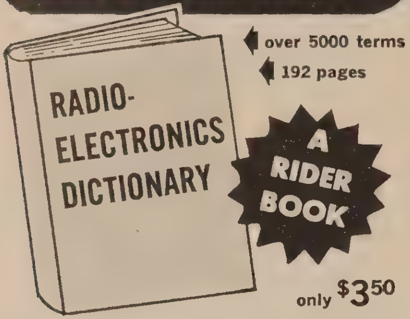

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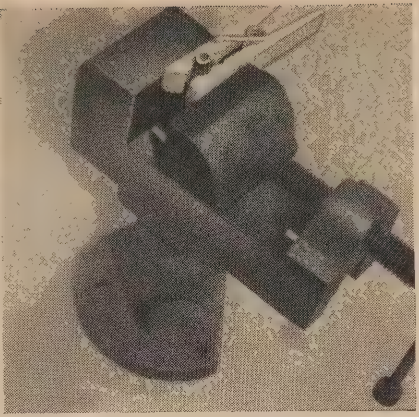

the vise for a better grip that prevents damage to the component.—*Harry J. Miller*

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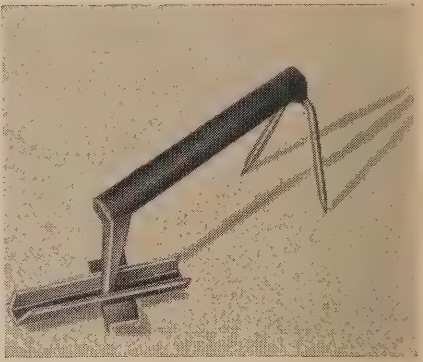

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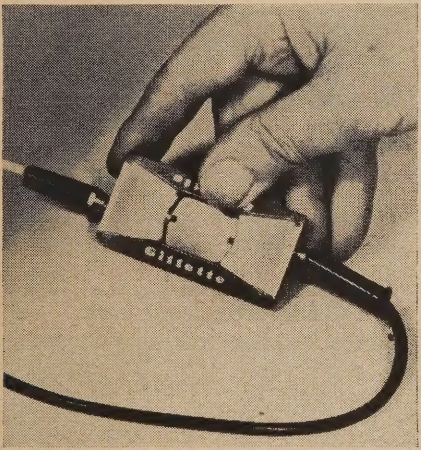
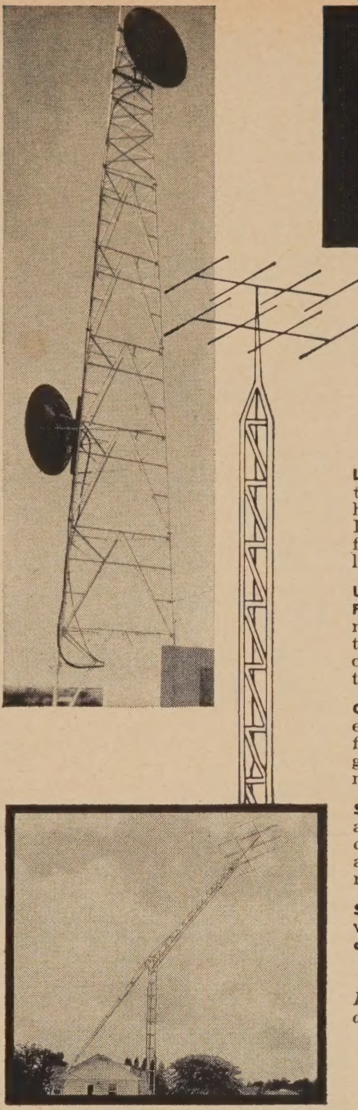


Soldering Kink

When soldering in cramped quarters on a crowded chassis, you can protect nearby components by slipping an asbestos sleeve over the heated surface of your iron. Fasten the sleeve in place, leaving only the tip of the iron exposed. The sleeve also helps conserve the iron's heat.—*John A. Comstock*

Cleaning Litz Wire

It can be difficult to clean and solder Litz wire—all the enamel must be removed, and the strands must not be broken. An easy way to do this is to heat the end of the wire, and then plunge this hot end into alcohol. The wires won't break, but will be cleaned and ready for soldering.—*Thomas R. C. Smith* END



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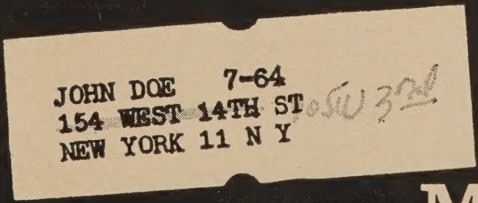

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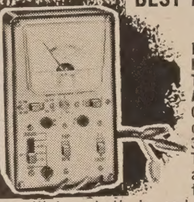

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What makes the *extra* difference is SPACE-PERSPECTIVE . . . the amazing headphone development which approximates more closely the sensation of listening to a stereo speaker system in a room. In ordinary headphone listening, left channel sound is confined to the left ear, and right channel sound to the right ear. In stereo speaker listening, sound from the left speaker reaches the left ear *and also* the right ear by means of the natural diffraction of sound waves around the head; and right speaker sound will reach the left ear in the same manner, thus resulting in what we all recognize as natural stereo sound in realistic perspective. SPACE-PERSPECTIVE adds this diffraction, which is missing in ordinary headphone listening, by electrically cross-feeding sound from one channel to the other to simulate the passage of sound waves around the head. You are now "in front of the speakers" via headphones . . . not in the middle where the sounds are isolated to each ear.

The CC-1 will operate with some other stereo headphones . . . but for best results the Jensen HS-1 'phones are recommended . . . the new professional stereo headphones which offer the most advanced features for top acoustical performance and comfort. The CC-1 Control Center sells for $39.95 . . . HS-1 Stereo Headphones for $24.95 . . . and a CFN-1 SPACE-PERSPECTIVE network only, with input jack, for $19.50. Write for Brochure MH. Jensen Manufacturing Company, Division of The Muter Company, 6601 S. Laramie Ave., Chicago 38, Illinois.

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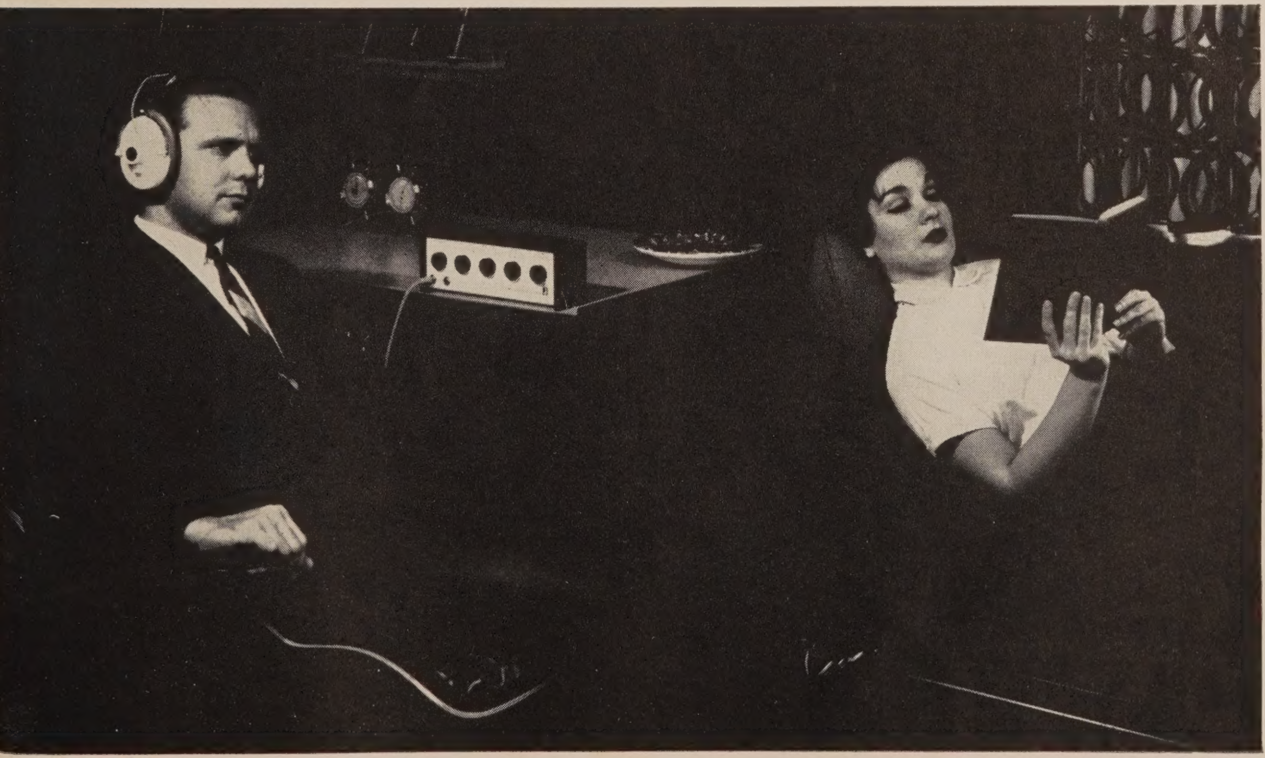

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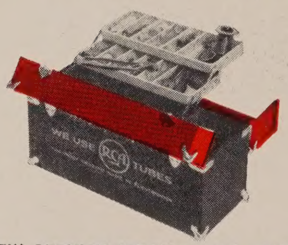

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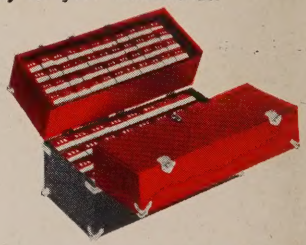

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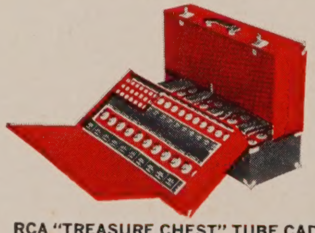

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